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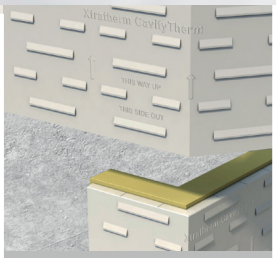

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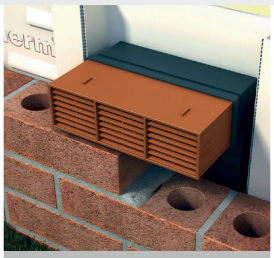

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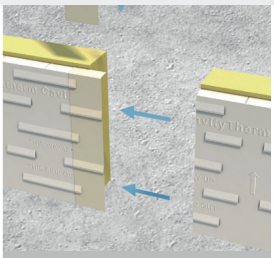

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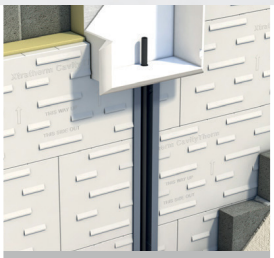

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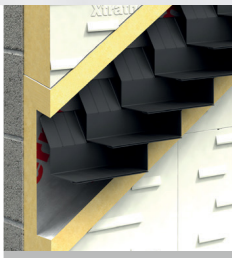

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editor's letter

Perhaps it's a subconscious response to the assault on the notion of an independent press emanating from Trump's America, but this issue of Passive House Plus contains what may be the beginnings of some meaningful investigative journalism on our part. I am well aware of the apparent absurdity of drawing an analogy between the work of a sustainable building magazine, and the vital role the world's leading press organisations play in acting as a break on the great orange one's autocratic instincts. President Trump can relax for now. Regrettably we have no dirt on him.

That is not to belittle the sustainable building sector. Climate change and the unsustainable consumption of finite resources are two of the gravest problems facing humanity, and the way we design, construct and use our buildings is profoundly important in tackling these twin crises. But it is not enough for us to merely advocate good or even best practice. Of course we will continue to work hard to provide our readers with the technical detail on how to realise sustainable buildings, and as usual there are some extraordinary pieces of inspiration in this issue, covered in painful detail. But we must do more.

Hopefully our exclusive report on the status of the EU's nearly zero energy building (nZEB) targets in the UK, in light of Brexit, will signal the beginnings of us sharpening our investigative focus on both sides of the Irish Sea. There is still much uncertainty ahead on this matter, given the article 50 process that the UK may be set to kickstart as we go to print. It's strangely fitting that when I contacted the four administrative areas of the UK to ask about their implementation of a key requirement for the sustainable building sector, the response from Northern Ireland was most non-committal of all. The officials may have been sick of the sight of sustainability-related questions. This is, lest we forget, a place where the government has just collapsed over a renewable energy subsidy scandal, which must be some kind of world first. (And what price is there on irregularities emerging on the RHI in mainland UK?) So with no functioning government, it's no surprise that the executive came back with a non-committal answer to questions I put to them on their plans regarding nZEBs.

But Brexit has placed Northern Ireland in a precarious position, and this must be a concern for the Irish and British governments. It's in all of our interests – for peace and prosperity on both islands – to redouble our efforts to forge stronger trade bonds, EU permitting, and in that regard the idea of ensuring we align our efforts around shared sustainable building goals such as nZEB makes lots of sense. And what better way of getting there than using international best practice approaches such as the passive house standard? Ireland already has an nZEB definition for new homes, but it's no co-incidence that the two Irish passive house projects featured in this issue – Niall Dolan's timber frame eco house in Galway and Durkan Residential's 59 unit block-built, competitively-priced passive house scheme in West Dublin — both meet the nZEB target, even though neither of them had to, and neither of them were designed with that in mind.

I'd wager that the two UK new build projects in this issue – a passive nursery in Aberdeen and a passive self build in Cumbria – would also pass Ireland's fairly onerous nZEB target, as would most of the buildings we have published over the years, where they have a sufficient amount of renewable energy too. The lesson is clear: if we can encourage the industry to aim for best practice rather than minimum compliance, we can help to minimise the damage that the likes of Brexit can do to both economies – and get better buildings to boot.

Regards,
The editor

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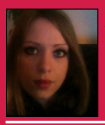
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contents

News

Exclusive: UK may deliver nZEB targets in spite of Brexit – while Scotland & Wales commit

Report: Jeff Colley

The Scottish and Welsh governments have pledged to implement a landmark EU policy that requires all new buildings to be nearly zero energy buildings (nZEBs), while England and Northern Ireland may follow suit, an investigation by Passive House Plus has revealed. Meanwhile, the UK is unprepared to meet a requirement that all new public buildings completed after 31 December 2018 are nZEBs, and the London Mayor's office is considering introducing energy demand reduction targets such as the passive house standard into its zero carbon plans for the city.

The recast EU Directive on the energy performance of buildings requires member states to make all new public buildings nZEBs by the end of 2018, with all new buildings following by the end of 2020, while also setting nZEB targets for refurbishments.

The Welsh and Scottish governments have issued statements to Passive House Plus including the verbatim response that they had "transposed all requirements of Directive 2010/31/EU to date and our intention is to continue to do so." The Welsh government said a forthcoming review of energy standards "is intended to deliver nearly zero energy requirements in line with the directive." The Scottish government cited a review of energy standards commencing in spring 2017, which will consider the 2013 Sullivan Report recommendations that the proposed 60 and 75% reductions in carbon emissions "would also deliver new buildings which meet the definition of 'nearly zero energy' new buildings in the EU Directive."

Meanwhile, a spokesperson for the Department for Exiting the EU has told Passive House Plus that the government will continue to implement current and forthcoming requirements of EU law up until the point that Britain leaves the EU. From then on the Great Repeal Bill, once enacted, will be used to "lift and shift" EU legislation into British law.

A Department for Communities and Local Government spokesperson said that the government implemented "the European requirement for 'Nearly Zero Energy Buildings' in changes to the Building Regulations in December 2012", but added that nZEBs "should be cost optimal and Member States are required to report against this. The UK's report to the European Commission in 2013 showed that standards are cost optimal. Our Housing White Paper sets out that we are undertaking a review of energy performance standards as required under the Housing and Planning Act 2016 – this will include a further review of cost optimality."

While this response may suggest that by adopting cost optimal standards, a member state already satisfies the nZEB target, the notion doesn't stand up to scrutiny. As the commission explained in guidelines on nZEBs issued to member states in July 2016, nZEBs may become cost optimal by 2020, as the standard becomes mainstream. "By then, technology costs are likely to be lower in reaction to more mature markets and larger volumes. It is therefore likely that the nZEB levels will correspond to the cost-optimum for 2020," the commissioned stated.

Member states were obliged to transpose Article 9 of the recast directive – which contains the nZEB requirements – by early 2013 and report on progress. The UK submitted a collective response for the four home nations, titled 'Increasing the number of nearly zero energy buildings'. The report stated: "The intent to deliver 'zero carbon' new buildings is one of the major steps that UK is taking towards meeting both its carbon targets and energy targets." It cited England's plans to introduce the zero carbon standard for new homes in 2016, a benchmark that included energy demand reduction, on-site renewables and, controversially, 'allowable' solutions — a carbon offsetting proposal. With similar plans in Scotland, Wales and Northern Ireland, the report proposed that zero carbon would "provide a suitable platform for both the definition and delivery of nearly zero energy new buildings" and renovations in line with EU requirements.

However, in 2015 then chancellor of the exchequer George Osborne announced that: "The government does not intend to proceed with the zero carbon Allowable Solutions carbon offsetting scheme, or the proposed 2016 increase in on-site energy efficiency standards, but will keep energy efficiency standards under review, recognising that existing measures to increase energy efficiency of new buildings should be allowed time to become established."

It has been widely reported that the UK is unlikely to implement the nZEB targets as it departs the EU, with UK Green Building Council (UK-GBC) policy advisor Richard Twinn telling Building magazine it was "unlikely" the target would be kept. "The government may well not decide to have nZEBs as nothing exists in UK legislation saying it has to meet that target," he said. The UK-GBC has also reported that the government has scrapped the zero carbon policy for non-domestic buildings.

However a European Commission spokesperson told Passive House Plus that "we understand that the UK has withdrawn the zero carbon Allowable Solutions carbon offsetting scheme, but not the targets as such.

"In the time available, we have obviously not been able to confirm this with the UK authorities and without further investigation we cannot conclude nor prejudge that there has been a breach of the Directive."

Responding to the news, AECB CEO Andy Simmonds said: "The Scottish and Welsh governments are representing citizens' interests with great integrity. They demonstrate basic economic common sense: their design and construction sectors will benefit from staying close to a modern and international construction industry - rather than a parochial one. Improved quality and climate-change preparedness of new buildings will reduce greenhouse gas and other harmful emissions and improve health and wellbeing for building occupants and the wider community. England would benefit from doing the same."

Since October last year, the Mayor of London has imposed a zero carbon planning requirement in the London area – targets which were retained after the government's zero carbon U-turn in order to help ensure the development industry in London is prepared for the introduction of 'nearly zero energy buildings' by 2020. The targets, which apply to all new buildings, currently include a 35% reduction in regulated carbon emissions on site compared to building regulations, with the remainder being accounted for via carbon offsetting. A spokesperson for the mayor said: "The Mayor is committed to lead by example in reducing carbon emissions across the Greater London Authority, as part of wider efforts to move towards London becoming a net zero carbon city by 2050. City Hall experts have assessed 'nearly zero energy building' requirements and believe that the Mayor's current policies meet or even exceed their carbon reduction targets.

"City Hall encourages energy demand reduction, as set out in the London Plan. We are aware of the Passivhaus requirement to meet an energy demand target. While we do not currently set targets for reducing energy demand, we will consider developing one in the future."

What are nZEBs?

The EU defines nZEBs as buildings with "a very high energy performance" as determined in accordance with the recast directive, which takes account of energy for heating, hot water, cooling, ventilation and lighting but not plug loads. The directive states that: "The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby."

Commission guidance from July 2016 on nZEBs advised member states to use benchmarks for four different climate zones. The examples given for the UK & Ireland's (oceanic) climate zone are as follows:

	Single family house	Office
Net primary energy	15-30 kWh/m²/yr	40-55 kWh/m²/yr
Total primary energy	50-65 kWh/m²/yr	85-100 kWh/m²/yr
On-site renewables	35 kWh/m²/yr	45 kWh/m²/yr

News

Councils must lead on green building — UK-GBC

The UK Green Building Council (UK-GBC) has published a green paper proposing a key leadership role for cities and local authorities in supporting the delivery of sustainable new homes and communities.

The paper follows the scaling back of ambitions for sustainable new homes by national government in recent years. 2015 saw the scrapping of the zero carbon 2016 target – a policy which had been in place for nearly ten years – and the wind-down of the Code for Sustainable Homes.

The new UK-GBC paper examines what local authorities in the UK can do, under their existing powers, to improve standards of new-build housing in their area, as well as what they can do as landowners. It suggests that local authorities can take a lead by, for example, requiring higher building standards on their own land, using tools like open book viability (which enables local authorities to scrutinise a developer's finances to see if more ambitious building standards can be achieved) running energy companies, and a range of other policy innovations.

It also reviews what devolution deals could offer, considering the potential for cities to develop large-scale spatial plans, work with industry to develop standards for higher quality homes, and bring budgets together to tackle health and housing issues holistically.

Julie Hirigoyen, chief executive of the UK Green Building Council, said: "In the current policy landscape, with ambition in sustainable housing at a national level falling short, it is vital we consider how local and city authorities can play a leadership role. This is the only way we will meet our stretching carbon reduction targets and deliver genuinely sustainable places.

"This paper proposes that cities should learn from existing best practices in respect of planning and design tools, and drive up sustainability standards for housing on their own land."

Meanwhile the UK-GBC has also published guidance for how construction clients can effectively commission embodied carbon measurements for their projects. The guidance explains some of the basics of embodied carbon and gives an overview of suggested approaches.

Both the green paper and embodied carbon guidance are available to download from www.ukgbc.org.

UK Passivhaus Awards seek large & small projects

The Passivhaus Trust is now seeking submissions for the 2017 Passivhaus Awards, which celebrate the best in UK passive house projects.

Now in their sixth year, the trust says the awards are designed to: celebrate that all passive buildings can be comfortable, healthy and beautifully designed; demonstrate that the passive house standard can be applied successfully to any building type, new-build or retrofit; and raise the profile and encourage uptake of the passive house standard.

Registration for the awards is open until 10 April in two categories: small projects with a treated floor area of 500 square metres or less, and large projects with a treated floor area greater than that. The small projects category is sponsored by Ecology Building Society.

The Passivhaus Trust says it is "looking for projects that are exemplary in architectural design and energy performance". Schemes must be completed and certified to the passive house or Enerphit standards. Schemes must also have measured building performance data available.

A panel of judges will decide the shortlist for the awards. Finalists will be announced in May 2017. The winners will be determined by Passivhaus Trust committee members, in conjunction with an attendee vote at the UK Passivhaus Awards Ceremony on 4 July in London.

Sponsorship opportunities are still available. For more information see www.passivhaustrust.org.uk.

(Below and right) Previous UK Passivhaus Award winners include Bere: Architects' Mildmay Centre in Islington, Kirsty Maguire Architects' Hayshed Passivhaus in Ayrshire, and HLM Architects' Tigh na Croit in the Highlands.

News

SAP ventilation changes could punish social housing projects

Changes proposed to SAP — the software used to demonstrate compliance with Part L of the building regulations and to generate energy performance certs — improve the accuracy of the assessment in some respects, writes Kate De Selincourt, but still allow poor design to hide behind optimistic default values, and may even outlaw some good passive house design practices.

Proposals in the draft SAP 2016 include changes to calculations for heat loss from district and communal heating systems, thermal bridges, solid walls, mechanical ventilation and hot water systems, plus changes to the CO_2 factors for fuel, and to Appendix P (overheating risk).

The changes for MVHR systems could prove particularly problematic, passive house engineer Alan Clarke told Passive House Plus. The new methodology aims to discourage MVHR installations in unheated loft spaces, but rather than requiring calculations, it simply asks whether the system is "exclusively within the heated envelope". If not, an in-use factor (ie assumed loss) of 50% is imposed.

"Locating an MVHR outside the thermal envelope is not in itself a problem, provided the distribution ductwork is inside the thermal envelope," Alan Clarke told Passive House Plus. This approach is used, for example, by social landlords to enable them to maintain MVHR units without relying on tenants.

"To fail to distinguish between MVHRs with minimal duct losses, and those catastrophic installations where losses may even exceed 50%, will have the unintended consequence of outlawing a sensible design approach."

Clarke is also critical of the assumptions relating to intake and exhaust ducts, where a system with any level of insulation — regardless of duct length — is awarded an optimistic default in-use factor of 0.8 to 0.9, when the real figure could be 0.05, he said.

Meanwhile, the over-optimistic distribution loss factors for district heating in SAP 2012 (of 5-10%) have been updated, and now range up to 50%. BRE research on 11 district heating systems has shown losses ranging from 23 to 66%. Higher loss factors were associated with more energy efficient buildings.

Appendix P (overheating risk) has also been refined to prompt more realistic assumptions about when occupants leave windows open, though Alan Clarke warned it may assume too much potential cooling via mechanical ventilation. Additionally, the revision to Appendix P still makes no provision for including the heat loss from communal supply of hot water in summer, despite the fact that this is a well-established risk factor for overheating in flats.

12-unit Shropshire passive scheme gets green light

Planning permission for 12 new affordable passive homes, designed by architecture firm Architype, has been granted by Shropshire Council.

Commissioned by Shropshire Housing Group, the greenfield site, which lies just outside the village of Much Wenlock, is one of a number of sites in the county identified by the group for affordable housing. The development will allocate 10 socially rented properties, with the remainder to be marketed for shared ownership.

The scheme is a mix of one to three bedroom houses, all of which are designed to achieve passive house certification. Architype said the passive house standard will offer residents a healthy and comfortable lifestyle, along with robust building performance that will keep operational costs to a minimum.

The design for the homes is the product of thorough community and client consultation by Marches Community Led Trust, the arm of Shropshire Housing Group that specialises in community consultation.

Special attention has been paid to the appearance of the properties, which sit comfortably within the local vernacular. The timber frame homes will be clad in an arrangement of FSC approved, UK grown, thermally-modified hardwood, along with locally sourced lime render and clay tiles.

The development is due to start on site in April 2017, when local Shropshire contractors SJ Roberts will begin groundworks.

(Above) An illustration of Architype's forthcoming timber clad passive house scheme near Much Wenlock, Shropshire.

News

Ecological to host unique CLT masterclass this May

Cross laminated timber construction has seen a vast increase in popularity in recent years. Projects are diverse and widespread throughout the UK, from multi-storey residential buildings in London to affordable housing projects on the Isle of Mull. The UK is now in a unique position to capitalise on the success and momentum of these developments, with more ground-breaking CLT projects planned.

Ecological Building Systems will host an event in London on Thursday 11 May, titled Insulating & Achieving Airtightness with Cross Laminated Timber. The event will bring together some of Europe's top experts on natural woodfibre insulation, intelligent airtightness and windtightness, and specialist fixing systems, for an in depth discussion on how best to optimise the design and on-site delivery of truly high performance mass timber constructions.

It is thought that this masterclass seminar will be the first of its kind held in the UK, and the event will focus on the very latest developments in delivering the highest specification for diffusion-open, healthy, low energy sustainable buildings using more natural materials, drawing upon Ecological's own experience of CLT projects in the UK.

Ecological Building Systems has been at the forefront of supplying sustainable building products to the UK and Irish market for over 15 years. This masterclass will give attendees the unique opportunity to engage directly with senior technical experts from Ecological's partners Gutex natural woodfibre insulation, Pro Clima intelligent airtight and windtight systems, and Heco specialist fixings manufacturers.

This day-long masterclass seminar will include a detailed focus on real-life CLT projects with Bernard Tulkens of Tectonics Architects and Will Garner, project architect and design manager at Midas Construction.

The course takes place on 11 May at the Building Centre, 26 Store Street, London, WC13 7BT. The cost is £120 with a 10% discount to members of the Passivhaus Trust, Green Register, AECB, ASBP, STBA and the Structural Timber Association. Booking is through Eventbrite. For further information regarding this masterclass event visit www.ecologicalbuildingsystems.com.

(Below) CLT is growing in popularity in the UK, and has been used to build ultra low energy buildings such as Tectonics Architects' Lansdowne Drive passive house.

Vienna hosts passive house conference in April

'Passive house for all' is the theme of the 21st International Passive House Conference, which takes place in Vienna on 28 and 29 April, along with an accompanying exhibition, at the Messe Wien Congress Centre.

Over 100 speakers from around 50 countries will give lectures over the two days of the conference. Divided across 16 working groups, they will focus on topics including passive high-rise buildings, the passive house and renewable energy, passive house in various climate zones, and passive retrofits.

Meanwhile, a total of nine workshops will take place from Monday to Thursday (24 to 27 April) prior to the conference. Topics include energy efficient hot water systems, cooling and dehumidification. In addition, courses dealing with the passive house planning tools PHPP and designPH are also on offer.

Following the conference, on Sunday 30 April 2017, conference visitors can choose to take part in one of six bus excursions to local passive house projects.

Vienna has been a hub of passive house construction for many years. In 2013, the city inaugurated the world's first high-rise passive house building, the 20-storey RHW.2 tower. The first passive house development with 800 plus residential units, known as Eurogate, is also located in the city. For more information on the conference see www.passivehouseconference.org.

Meanwhile the world's first ever passive house, the Darmstadt home of Passive House Institute founder Dr Wolfgang Feist, has had its passive house cert upgraded to 'passive house plus', in recognition of the renewable energy it now produces.

About a year ago, a 26 square metre solar PV array was installed on the roof of the house, which was built in 1991. Passive house plus is a new category of certification that, along with the passive house premium category, recognises on-site renewable energy production.

"Passive house buildings are perfectly equipped to utilise renewable energy. With their extremely low heating energy demand, it is even possible to derive as much energy from the sun on-site as is consumed in the house over a year," Dr Feist said.

(Above) Built on the site of OPEC's former headquarters, the RHW.2 tower in Vienna is the world's first certified passive high-rise.

News

Bow Tie & Beattie collaborate on 3-storey London passive house

Leading passive house contractor Bow Tie and build system provider Beattie Passive have begun collaboration on a series of passive house projects in London and surrounding areas, with Bow Tie recently supplying labour for the erection of a three-storey Beattie Passive house in Clapham, South London.

Two trees located at the site frontage prevented a crane from being used for deliveries, so all elements were produced at a size that could be unloaded and moved around the site by hand. The build team took the project from foundations to a complete structure in just 14 working days. Ron Beattie, head of Beattie Passive, led the team on site himself for several days. Sales and marketing personnel from both companies and even the client himself all pitched in, eager to experience the process first-hand. A video is now being produced documenting the build.

Both companies are now working towards Bow Tie Construction becoming Beattie Passive's approved contractor for turnkey builds in London and the surrounding regions. Bow Tie has also recommended the Beattie Passive system to a number of clients due to its robustness in flood risk areas, and its built-in passive house certification.

(Right) A Beattie Passive timber frame system constructed on a tight site by Bow Tie for a passive house in Clapham.

Green Register & Warm to run half-day passive workshops

The Green Register and Warm have again teamed up to run a series of half-day technical passive house training sessions in 2017, after the first run of courses was met with great enthusiasm last autumn. This year's workshops take place in London, Bristol and Manchester.

In a blog post published on The Green Register's website, Neil Turner of Ecological Building Systems provided an overview of last year's courses.

"Based on my career background I was fully aware of the typical building envelope insulation and airtightness requirements for passive house construction, but wanted to learn more about other aspects and gain a perspective from other construction professionals," he wrote.

"In the first training session on principles of passive house construction, Peter Warm very clearly explained the five key aspects of passive house — building shape (form factor), glazing, airtightness, ventilation and envelope insulation/thermal bridging at junctions. What struck me most is the simple and straightforward principles – I had previously imagined that it would be far more complicated and complex, and that there would be some major design restrictions and limitations."

Turner continued: "The second session from Bill Butcher covered construction detailing. As an experienced builder, Bill was able to explain key elements such as how to achieve airtightness (products and construction sequencing), non-repeating thermal bridges at junctions, proven construction build-ups and the correct fitting of insulation in a very practical, accessible way."

Turner said passive house M&E consultant Alan Clarke's session on building services for passive house, which focused on mechanical ventilation with heat recovery (MVHR) systems, hot water and heating, was a particular highlight. "I was fascinated by aspects such as optimum places to store MVHR, water tanks and hot water combi units and how much heat can be lost from water pipes if they are located too far away from the heating units."

In the final 'crit' session, delegates brought drawings of their own projects and discussed how design modifications could help achieve the passive standard. The range of delegates' projects was diverse, from the design of an awkwardly-shaped new school, to an extension to an elderly persons care home with mostly north facing windows. "It was clear from the discussions amongst delegates that they had absorbed and could already apply the knowledge learned in the previous three sessions," said Turner.

For more information on this year's sessions visit www.greenregister.org.uk.

(Above) Delegates going through drawings from their own projects during a 'crit' session at last year's passive house training session, hosted by the Green Register and Warm.

News

Lambeth Council completes three Lime Green-rendered timber frame passive houses

A recently completed social housing project for Lambeth Council at Akerman Road in south London includes three new passive-certified terrace houses, and six highly energy efficient retrofitted flats within a locally listed building. The construction solutions and details were designed by the 15-40 Architecture Collective.

Ensuring vapour open construction was a priority. Highly insulated houses must consider moisture management, with moisture damage being the greatest risk factor to the building fabric. The new-build terraces were constructed using the PH15 timber frame system from Passivhaus Homes, which offers a natural insulation solution to passive house projects, thus ensuring the building can 'breathe', allowing moisture to escape through the structure.

Products used as part of the PH15 timber frame system enable water vapour to escape externally – including Lime Green's Warmshell render system, which was applied directly to external woodfibre insulating boards. "Lime Green renders are highly breathable and elastic, with low water absorption, which means they will provide a very durable finish and importantly have far less embodied energy than other render systems," Dominic Putnam of Lime Green Products told Passive House Plus.

"Lime Green Products offer approved installers to ensure their lime based products are applied correctly on site, important given that this is a natural product. Lime Green also provide excellent technical support and training, and a wide variety of colours and finishes are possible."

The PH15 timber frame system is a part offsite solution developed specifically for passive house levels of energy efficiency. The PH15 frame elements are all pre-cut offsite and individually coded — like a Meccano set, rather than fully panellised. "This is both an economic solution and avoids the need for heavy lifting equipment," said Puttnam. The system can be delivered where there are limited or difficult access conditions. The PH15 shell relies on typical UK carpentry skills only, supported by onsite training and a technical help line.

Lime Green Products also manufacture a range of natural lime renders and insulation solutions for retrofit projects where moisture management is particularly critical. Dominic Putnam told Passive House Plus that the company's Warmshell internal insulation system addresses the common problems of damp and condensation, while also addressing heat loss and contributing to a healthier indoor environment.

The passive house units at Akerman Road boast space heating demand of 9.1 kWh/m^2/yr, heat load of 7.9W/m^2, and airtightness test results ranging between 0.34 to 0.4 ACH at 50 Pascals. To learn more about the PH15 timber frame system go to www.phhomes.co.uk, and for more information on Warmshell insulation and render systems go to www.warmshellinsulation.co.uk.

(Below) A Lambert Council scheme of three certified passive houses on Akerman Road, South London, built using a lime-rendered wood fibre external insulation boards on a PH15 timber frame wall.

Gerband gets 50 year durability cert for airtight products

Leading airtightness manufacturer Gerband has received 50 year durability certification from the University of Kassel in Germany for three of its premier airtightness products.

The certification has been awarded to Gerband Sd2 vapour control and airtight membrane, Gerband 586 airtightness tape, and Gerband Fortax 6400 internal adhesive sealant.

"This certification is a testament to the outstanding performance and durability of Gerband airtightness products, said Chris Ambrose of Passive House Systems, suppliers of Gerband products in the UK and Ireland. "We can now say with confidence that Gerband products will last 50 years or longer, and have the independent testing to prove it."

The accelerated ageing test developed by the University of Kassel — the only approved method for testing the durability of adhesive joints in airtight constructions — took place over 420 days. The test was performed in accordance with the draft standard DIN 4108-11, for the durability of adhesive products in airtight constructions.

Gerband also continuously perform their own in house testing to ensure consistent quality throughout the lifecycle of its products. Passive House Systems, with offices in Essex and in Ireland, specialises in airtightness products and systems. For more information see www.passivehousesystems.co.uk.

(Left) The Gerband airtightness system, available in the UK and Ireland via Passive House Systems.

News

Architectural education must focus on occupant well-being — UCD lecturer

The co-ordinator of a sustainability-focused architectural masters programme in University College Dublin, Ireland believes that education in building design needs to focus more on the health and well-being of building occupants, as well as the numbers-driven approach of energy efficiency and resource conservation.

Paul Kenny is a lecturer at the university's School of Architecture, Planning and Environmental Policy. Together with his colleague Vivienne Brophy, he co-ordinates the MArchSc in Sustainable Building Design & Performance. He told Passive House Plus that the course is somewhat unique in Ireland in taking such an occupant-centred approach to sustainability.

"At the moment the sustainability agenda is largely energy and technology driven, but there's a growing emphasis now on occupant health and well-being in a more balanced sustainability agenda," he said.

"There is today a real need for greater awareness of indoor air and environmental quality, comfort, daylight, quality of life and mental well-being, much of which has played, at best, second place to energy matters for decades. While energy and its polluting emissions remain a priority in building design, so too is the well-being of building occupants. In the so-called developed world we spend 90% of our lives indoors."

"The course is designed for people from a background in architecture or similar disciplines looking to define themselves within the area of sustainability," he explained. "Our aim is to provide a body of highly knowledgeable graduates who can go into architectural practices with a broad and creative sustainability mindset."

The course, which is now in its fifth year, is a one-year taught programme that runs from September through August and has a major emphasis on practical studio design and research work. Core modules include 'sustainable building systems', which looks at how buildings can conserve energy, materials and water, and at "technologies, components and materials suitable for zero energy new build and cost-effective retrofit". There is also a core module in 'sustainable design & the occupant', which places a particular focus on occupant physiology, psychology and health.

Other core modules include the 'sustainable building analysis studio', and the 'field studies' module, which comprises an international study trip to exemplary sustainable buildings. There are also optional modules in parametric design, placemaking: urban & rural design, and in geographical information systems, amongst others.

For more information on the masters programme, see www.ucd.ie/graduatestudies.

Housing minister addresses first nZEBRA conference

The inaugural nZEBRA conference was held in Enniscorthy, Co Wexford, Ireland on 2 March, and aimed to draw attention among policy makers, building designers and construction professionals to the rapidly approaching introduction of nearly zero energy building (nZEB) standards in Ireland.

The conference was organised by nZEBRA, a recently established consulting and education firm specialising in nZEBs and servicing the Irish, UK and US markets, spearheaded by Passive House Academy founders Tomás O'Leary and Art McCormack, along with thermal bridging expert Andy Lundberg of Passivate.

The conference included presentations on nZEB policy, case studies, costings, performance monitoring and real-life experiences of nZEB dwellers.

The EU's recast energy performance of buildings directive requires that all new public buildings completed after the end of 2018 be nZEB-compliant, while the rule will apply to all new buildings completed after the end of 2020. Member states are entitled, within limits, to come up with their own definition of nZEB.

Speaking at the conference, Minister Coveney said that the "benefits associated with nearly zero energy homes such as improved levels of comfort, drier less damp indoor air quality and reduced energy and heating bills have a very positive effect on health and wellbeing of our citizens."

He spoke about the housing crisis, and said that "while it is important we deliver housing in a short timeframe it is equally important that we deliver quality, durable and energy efficient housing".

Coveney said the government would soon draft a bill to put Ireland's construction industry register on a statutory footing, providing legislation for the registration of builders, contractors and specialist sub-contractors.

An even larger nZEBRA conference is now being planned for later in 2017, Tomás O'Leary told Passive House Plus, which will examine how nZEB policy applies to larger buildings, and will aim to draw international attendees.

Speakers at the conference included the Irish Minister for Housing Simon Coveney, former European Parliament president Pat Cox, Sustainable Energy Authority of Ireland CEO Jim Gannon, Construction Industry Federation director general Tom Parlon, Wexford County Council chief executive Tom Enright, Dún Laoghaire-Rathdown county architect Andrée Dargan, Department of Housing advisor Seán Armstrong, Michael Bennett Construction QS Seamus Mullins, University of Ulster academic Dr Shane Colclough, EnEffect director Dragomir Tzanev, ILTP Consulting MD Christy O'Sullivan, and all three nZEBRA directors, along with the owners of two separate nZEBs which share the rare distinction of being A1 rated passive houses – Monica Hackett and Francis Clauson.

(Above top) Irish housing minister Simon Coveney speaking at the nZEBRA conference. (Above) Pictured at the nZEBRA conference are (l-r) SEAI CEO Jim Gannon; Department of Housing advisor Seán Armstrong; Wexford County Council's Enniscorthy district manager Liz Hore; nZEBRA director Tomás O'Leary; Wexford County Council chairman Paddy Kavanagh; housing minister Simon Coveney; Wexford County Council chief executive Tom Enright; minister of state Paul Kehoe; and Construction Industry Federation director general Tom Parlon.

News

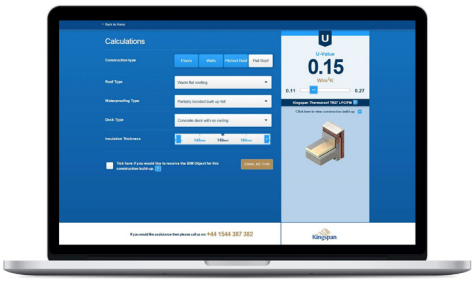
Kingspan Insulation releases new BIM objects

Kingspan Insulation is helping to streamline the specification process with the release of over 500 new flat roof BIM objects. The objects, available on Kingspan's popular U-value calculator app and website (www.uvalue-calculator.co.uk), cover a wide range of green and warm roof constructions, all featuring high performance Kingspan Therma range products.

From the intuitive U-value calculator menu, users can specify their desired U-value and adjust virtually any element within the construction. By ticking a request box at the end of the calculation process, users can now have the BIM object for their Therma range flat roof construction sent to them via email along with their U-value calculation. The objects are attached as a Zip file in both IFC and Revit formats.

Kingspan Insulation's U-value calculator is available as a free app for Apple, Android and Windows devices. It includes over 8000 calculations for floor, wall and roofs, all pre-calculated by a member of Kingspan Insulation's technical services department who is approved under the BBA/TIMSA scheme for calculation competency for U-value and condemnation risk. Where appropriate, these calculations also take into account fixings and bridging factors.

In addition to the new flat roof objects, a wide range of Kingspan Insulation BIM product objects are also available for free download from the NBS National BIM Library. For further information, see www.kingspaninsulation.co.uk.



Scotframe & partners deliver Scotland's first passive university building

Leading timber engineering company Scotframe supplied the main structural components for the first certified passive building in a Scottish university. The full-kit manufacturer and supplier provided the wall and roof solutions for the University of Aberdeen's showpiece Rocking Horse Nursery, which is profiled in this issue of Passive House Plus.

For the project, Scotframe supplied Val-U-Therm panels, which helped to deliver class-leading energy performance for the newly-completed £2 million building, the first pre-school facility in Scotland to adopt the passive house standard.

The project, carried out by Hybrid Build Solutions, was a collaboration between Scotframe and Glulam Solutions of Inverurie. Philip Edwards, who has a sales and estimating role at Scotframe and is also a director of Hybrid Build Solutions, said: "We supplied factory-insulated Val-U-Therm exterior wall panels and roof cassettes which are well in excess of most existing thermal performance standards. The wall panels were 235mm and the roof cassettes were 300mm deep."

The system achieved airtightness of 0.48 air changes per hour, well inside the passive house standard of 0.6 ACH. Syd Birnie, director at Glulam Solutions and Hybrid Build Solutions said: "We worked with the architect and contractor to offer the most cost-effective thermal solution. This allowed us to use the Val-U-Therm™ system alongside the supporting glulam frames, which helped substantially in achieving the extremely high levels of thermal and airtightness performance necessary for the passive house accreditation."

Calum Proctor, project manager at Aberdeen University, said: "Together we've delivered a building of very high quality which meets the challenging passive standard. The children and staff are very much enjoying their new home, and that is thanks to all who were involved." The Rocking Horse Nursery building, which caters for 78 children in the University community, used more than five kilometres of specialist airtightness tape.

The university building is the latest passive house project for Inverurie and Cumbernauld-based manufacturer Scotframe, the largest timber frame manufacturer in Scotland and the third largest in the UK. It marked its first quarter century in 2015 with a record 160 employees and annual sales in excess of £35million.

(Above) Rocking Horse Nursery, a certified passive timber frame building at the University of Aberdeen, which is the subject of a case study in this issue of Passive House Plus.

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So then, does each home really count?

At the end of last year, the British government finally published its 'Each Home Count' review into the country's home retrofit industry. So was it worth the wait? Yes, says Peter Rickaby, a member of the review implementation board — the report's recommendations simply must be implemented, or else the goal of drastically cutting carbon emissions from the UK's building stock will wither and die

Was the report of the Each Home Counts (Bonfield) review worth waiting for? The review examined consumer advice and protection, quality standards, and monitoring and enforcement in the home energy retrofit and home renewable energy industries in the UK.

Having been involved in the review, I am not best placed to answer this difficult question, but here goes. The report was published quietly just before Christmas (read it at tinyurl.com/eachhomecounts), after a delay caused by pre-referendum purdah, post-referendum chaos, the change of government, a departmental reorganisation and the need for new ministers to familiarise themselves with their briefs. The review was completed last March, so we have waited a long time for what may seem at first inspection to be a curate's egg.

On one hand, many of its 27 recommendations, including the quality mark, the customer charter and the code of conduct have a warmed-over 'Green Deal 2' flavour to them (the Green Deal being the previous Conservative/Liberal Democrat government's failed, flagship attempt at stimulating home retrofit). Others recommendations are well-founded but aspirational, and the report is perhaps off the pace technically, in terms of what is known about why and how retrofit goes wrong, and how to do it well. The expertise developed by former fellows at the Centre of Refurbishment Excellence (Core), and collated and translated into training first by Core and now by the Retrofit Academy, hardly features.

On the other hand, there are many welcome ideas and propositions in Each Home Counts, including: the need for a whole-house approach to retrofit, the need to improve skills and training across the industry, the need for a framework of sound technical standards, and the need for a single, well-focused quality assurance scheme to provide consumer confidence. Members of the building fabric work-stream developed an excellent model for quality assurance at every stage of the retrofit process, including: engagement with the householder, gathering information ('richer, smarter assessment'), design, installation, commissioning and handover, and monitoring and evaluation.

The detail of this model didn't make it into the report, but many ideas that underpin it are already being taken forward. The BSI Retrofit Standards Task Group has started work on a framework of retrofit standards focused on what is done to the house, rather than on the competence of those who do it. PAS 2030, a retrofit specification and Green Deal legacy that was clearly unfit for purpose, has been comprehensively revised, and the new version (PAS 2030: 2017) includes provisions for design, for consideration of the interactions between retrofit measures, for construction details at corners, junctions and edges, for moisture management and for assessment — and if necessary upgrading — of ventilation whenever insulation is installed.

A disappointing aspect of the review is its failure to interrogate and dispose of the certification bodies (CBs) that have presided over many retrofit disasters during the last five years. If the CBs, mostly of Green Deal provenance or working in industry silos, cannot stop these failures happening, what are they for? Some review contributors wanted to sweep away the hundred or so CBs working in the retrofit sector, and replace them with a single quality assurance body for the whole industry. Perhaps that was a naïve aspiration, but what we have ended up with instead is one hundred and one bodies jockeying for position in a diffuse quality assurance scheme, and a nightmare task for whoever gets the job of herding these particular cats.

The agenda for the Each Home Counts Implementation Board, or the body that will soon replace it, is challenging. There is a framework of standards to build and promote; a training and skills enhancement curriculum to establish; an advice service to develop for householders and members of the industry (especially those in small organisations, and one-man bands); a data warehouse to build, which can accept auditable information about every stage of the retrofit process, from engagement to evaluation; and a quality assurance scheme to implement, with teeth sharper than those of the Health & Safety Executive.

Achieving all this will take time, money, vision, commitment and leadership. But here is the flaw: nobody will invest time and money unless there is some prospect of a return on their investment. The government's current stance is that domestic retrofit is politically toxic, so the retrofit industry must implement the Each Home Counts recommendations to put its house in order and ensure that it delivers what it says on the can. Only then will the government consider promoting or (dare I say it?) subsidising domestic retrofit, to give us a chance of meeting our emissions reduction targets.

So the challenge is to make the government understand that promotion of retrofit must go hand-in-hand with the implementation of Each Home Counts, not follow-on afterwards. If we don't change the government's stance nobody will invest, Peter Bonfield's recommendations will wither on the vine, and before long there will be no retrofit industry left to deliver the vision.

Was Each Home Counts worth waiting for? Yes, definitely. It is neither the beginning nor the end of our difficult retrofit journey, but it defines new challenges and points a clear direction of travel.

Peter Rickaby is director of Rickaby Thompson Associates Energy + Sustainability Consultants, and a trustee of the National Energy Foundation. He chairs the BSI Retrofit Standards Task Group and is currently a member of the Each Home Counts Implementation Board. The views expressed in this article are his own.

Our passive journey: Getting the right advice

In the fifth instalment of her column on designing and building a passive house for her family, Nessa Duggan talks about the importance of getting good advice — on everything from airtight sliding doors down to your choice of timber flooring.

Eager to soak up as much information as possible on our passive journey, we couldn't pass up the opportunity to avail of the nZEB Open Doors event on 12 November last year. The most convenient location for us to visit was a three-unit passive house development in leafy south Dublin. It was a bright crisp day, about 10C outside, sunny with a few passing clouds.

The development's main contractor, Pat Doran Construction, was our host. Active discussions arose on all aspects of the build to date, including challenges associated with the decision to aim for the passive house standard after planning permission was granted, and the impact of that decision on different aspects of the project. The detached masonry build had beaten the 0.6 ACH passive house airtightness target during a blower door test a few days earlier. But with the plasterboard not yet installed, this was an ideal time to see the critical internal workings of the building, including airtightness membranes and MVHR ducting. It was also easier to see how cold bridges might occur at points where elements of the house come together, creating a path of least resistance for heat to trickle out of the structure.

> "These voices of reason have been invaluable throughout this project, as the learning curve has been very steep."

Despite the relatively clear day and large glazed elements, it was colder inside than out — not much evidence of the power of passive solar gain. But we learned that due to the less than optimal orientation in the design, to achieve the passive house standard the PHPP calculations dictated very high U-value specifications for the floor, walls, windows and roof, adding considerably to the cost.

It is likely our own house will be timber frame, but nonetheless it was useful to understand the implications of choosing that over masonry. Visualising and chatting about the challenges associated with masonry construction, and the challenges associated with aiming for the passive house standard after the design was finalised, highlighted the importance of careful planning of critical details. For us the trip was well worth the effort, and we left with a much better appreciation of the value of meticulous planning for this type of project.

With planning for our own house granted, we focused on other essential technical information when assembling a tender package. It is important to us that everybody we engage has a good appreciation for passive house principles and construction. I asked around and following recommendations we engaged with Tanner Structural Designs Ltd and Jot Energy Ltd. Both were very responsive to queries — not always a given in my experience. Activity in the industry must be on the up, as plenty of the queries we sent out went unanswered.

Of particular interest was Tanner Structural Designs' expertise in the design of insulated foundations and breathable timber frame construction. The company's Hilliard Tanner was a mine of information about the options we needed to consider with regard to the civil works on the project. He also pointed out some issues with the design specifications in the roof that were quickly resolved. Completing construction drawings felt like a big step forward.

Meanwhile Jeff O'Toole of Jot Energy has a background in construction, an MSc in Sustainable Energy Engineering, is a certified passive house consultant and a BER assessor. Jot Energy also provide airtightness testing and thermal imaging services, and having a single point of contact for all things associated with getting the performance of the house optimised was extremely attractive.

Jeff drew our attention to the large sliding doors, giving us a lot to think about. In order to achieve the passive standard, the doors could potentially cost €20,000 each. This is in part associated with balancing the less than optimal volume-to-floor area of the overall design, and the high spec required to manage airtightness. If this was brought to our attention during the design process, the feature would have been less appealing as there is no great panoramic view from the site.

With a road map for the technical stuff almost complete, consideration for basic internal finishes is moving up our list of priorities. Joinery is the current hot topic for research. I've always loved walnut but recently met the voice of reason at a local supplier's showroom, with my darling eight and five-year-old sons in tow.

When I mentioned walnut, the supplier asked with a nod, 'are there any more of those?', and when he heard there was another two-year-old, he immediately said: 'you don't want walnut'. Then he proceeded to demonstrate just how easy it is to scratch. With three very active boys, I can easily imagine how walnut joinery will look after a few months of collisions.

So it's back to the drawing board in an attempt to rewire our long-term admiration of walnut, and the notion that it was going to be integral to the internal finish of our new house. It's a home we're building not a show house, and we all need to enjoy it rather than look after it so it can look pretty. These voices of reason have been invaluable throughout this project, as the learning curve has been very steep.

Sometimes it feels like this project takes one step forward and two steps back. It seems that revising and reviewing as each new piece of information becomes available is all part of the balancing act of complying with the planning permission, building regulations, the passive house standard and our priorities and preferences for our family home.

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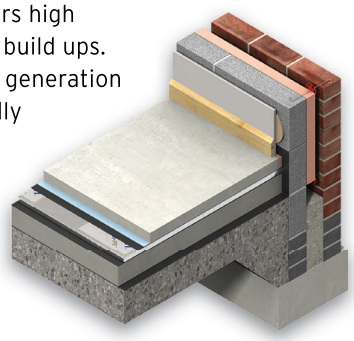

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Time to move beyond the architecture of the oil age

We must discard the architectural baggage of the 20th century to solve 21st century problems – argues our new columnist Marc Ó Riain – and relearn some lessons from before the advent of oil.

We once knew how to design and build buildings properly. But in the oil age we forgot or decided that other concerns, like aesthetics or cheap construction were more important than durability and functionality. As we lobby for adequate standards to address the environmental crisis, we need to understand why we don't seem to care, what drives political decision making and why many in our industry are so resistant to change.

We once knew but we forgot.

Greek architecture informed Roman architecture. Vitruvius recorded the techniques, skills and design strategies in De Architectura, the ten books of architecture which set out engineering technologies for drinking water, sanitation and building heating systems, materials, building orientation, proportion, light and climate. Wotton's (1624) translation of such texts enabled stonemasons to learn from the amassed knowledge of the field. Indeed, masons well understood the impact of climate on buildings, as they preferred locating houses in valleys over hilltops, where "the stormy blasts of winter, should breed them (occupants) greater annoyance" (Harrison 1587). Stonemasons and early architects built upon a classical understanding of orientation, room scale, material and function. Great estate houses of the Romanesque Revival (1840) depended on natural light and heating by open fires. It was perhaps a shame that the hypocaust underfloor heating systems found in the early British roman villas (like the one excavated at St Albans), had not been revived at the same time. The architect's role began to be distinguished from the master mason in the seventeenth century (Neveu 2008). The Palladian buildings that arose after these translations demonstrated a clear correlation between size of rooms and sizes of openings, daylight and heat loss. Large windows allowed natural light in and rooms were limited by the size of windows and quantity of light. Stone walls absorbed the heat of the fires, releasing the heat slowly at night. Indeed, Hawkes argued that Hardwick Hall (1597) was oriented to store heat from the sun in a trombe wall effect.

The architect was seen as having an appreciation and knowledge of aesthetics, rather than construction (Perrault). Architects did not start out well according to Banham (1969), who recorded that that they were indifferent "to the environmental performance of their buildings". That said the styles of the Palladian villas began to inform the urban houses and terraces of the cities. Recent research by Scottish Heritage showed that timber shutters performed better than double-glazed windows at retaining heat in a building. The high point of building design would come around 1900. Arts & Crafts movement buildings like the Broad Leys House, Voysey (1898) embraced optimal orientation, creating double height bay windows for light, a cantilevered balcony creating a ground floor veranda to the south for shelter and shade, placing service areas in the east of the house and having window sizes environmentally appropriate to room function and orientation. By the turn of the twentieth century, this would demonstrate a steady advancement in the understanding of building physics and how a building's design relates to its environment, climate and location.

> "Stonemasons and early architects built upon a classical understanding of orientation, room scale, material and function."

However, all would be about to change with a paradigm shift towards modernism, which still casts a long shadow that dominates much of architectural practice and education today. Modernism was a reaction to ornamentation, as Loos (1908) condemned ornament as crime. An Italian Architect, Sant Elia, created the manifesto for modernism and brutalism "With the use of concrete, steel and glass…to be ugly in its mechanical simplicity".

This revolution would see seminal architects like Gropius, Meyer and Le Corbusier look toward industrial buildings and a 'plastic' or flat aesthetic with large gridded windows and thin concrete walls. Buildings like the Fagus Werks building (1913) began to define an aesthetic approach to buildings that lacked the environmental performances of the amassed knowledge that had preceded it. Modernism rejected all that had gone before seeking to create a 'Tabula Rasa', a clean slate. The Fagus Werks building suffered from overheating with awning later retrofitted to ameliorate the issues with the strip banded glazing. According to Feuerstein (2002) the Dessau Bauhaus building (1924) suffered from "undersized and inefficient heating, huge heat gain and heat loss from the expansive, unprotected and non-insulated glass façades, poorly maintained roofs, which led to leakage…". City of Refuge (1933) by Le Corbusier, another seminal leader in the modernist movement, was a functional failure. His experiments with active double skin façades (murs neutralisants), mechanical ventilation heat recovery (respiration exacte) and airtightness would be almost 60 years ahead of passive house, but led to insufferable living conditions for the homeless occupants.

These buildings and their architects created a movement that has dominated European and American architecture for over a century. The 'plastic' aesthetic has transmuted today into the characterless glass boxes that purge our cities, decimating diversity, personality and urban grain. But why has the paradigm of modernism been so dominant and why have architects not shifted toward a more environmentally enlightened practice? The design of buildings within the modernist paradigm is not simply informed by aesthetic priorities but also by budget limitations and building standards. The first zero energy building was constructed in Copenhagen in 1975. We should start to question the reasons for the lack of progress and the lack of aspirational building standards today. In truth the reasons are tridental; a modernist architectural bias to the plastic form, inadequate minimum building standards (especially in the commercial context) and capital centric investment models that ignore the benefits of lower operational costs/healthier indoor air qualities.

In the next issue we will explore the impact of cheap oil and government policies on renewable technologies and building standards.

Marc Ó Riain is the president emeritus of the Institute of Designers in Ireland, a founding editor of Iterations design research journal and practice review, a former director of Irish Design 2015, a board member of the new Design Enterprise Skillsnet and has completed a PhD in low energy building retrofit, realising Ireland's first commercial nZEB retrofit in 2013.

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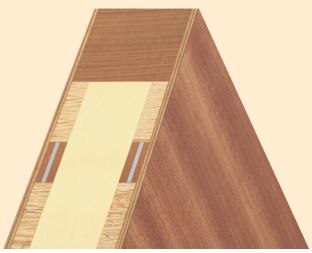

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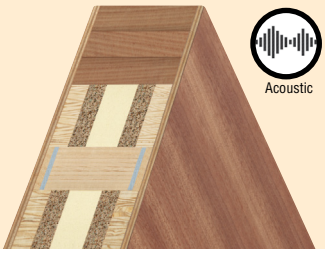

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Out of control?

After a litany of dangerous and high profile building failures in Ireland, many in the country's building industry looked longingly across the Irish Sea and held up the UK as an example of how to do building control properly. But following a series of embarrassing defects with UK construction projects, it's clear the British system is far from perfect. So is either of these building control systems properly equipped to deliver safe, healthy and well-constructed buildings?

Words: John Hearne

There's a lot of house building in the pipeline. In the UK, the government has committed to building 200,000 new homes a year during the lifetime of the current parliament. Meanwhile, in Ireland, the government has announced that 30,000 homes in major cities will be 'fast-tracked' in the next three to four years, as part of its plan to deal with the ongoing housing crisis. The government's 'Rebuilding Ireland' programme also envisages a doubling of the output of overall housing from the current levels to at least 25,000 per year by 2020.

At the same time, defective buildings are rarely out of the news. A 2015 survey from the Home Builders Association in the UK found that 93% of buyers report problems to their builders, with 35% of those reporting 11 problems or more.

Last April, 17 schools had to be closed in Scotland over safety concerns relating to faulty construction, after the masonry walls of some school buildings fell down in high winds. Meanwhile Orchard Village, a flagship residential development by the Clarion Housing Group in East London, has been plagued by reports of leaks, damp and mould, structural defects, inadequate fire proofing, and lack of insulation. And housebuilder Bovis Homes is now paying £7m to repair the poorly built dwellings it sold to customers.

A recent report by the housing charity Shelter emphatically concluded that England's housebuilding system is rigged to favour developers and speculators rather than families, and that the system results in high-price, poor quality homes.

In Ireland, developments like Priory Hall, Longboat Quay and Millfield Manor have become bywords for bad building practice. In the latter case, to pick just one, six houses in Millfield Manor burned to the ground in less than half an hour on 31 March 2015. A subsequent report by a fire consultant found 'life threatening' defects in other houses in the development.

Meanwhile Balgaddy, a major social housing development built in west Dublin at the height of Ireland's construction boom, has been plagued by reports of damp, mould and structural defects. And the European Committee of Social Rights, an arm of the Council of Europe, is expected to adjudicate this year on a complaint by residents of 20 Irish local authority housing estates relating to substandard housing.

So if we're going on a building spree, are there any guarantees about the quality of housing we're going to get?

In Ireland, Building Control (Amendment) Regulation SI9 was introduced in March 2014 as a response to that challenge. BCar, as it is now known, establishes a paper trail to document all building activity on a project and identify those responsible in the event of a defect occurring. An 'assigned certifier' drawn from the ranks of architects, surveyors or engineers is required to sign off on each stage of the build. This person is then theoretically responsible should anything go wrong.

Ensuring good building practice is of course about much more than just building control. It's a multi-faceted objective, bringing in building regulations, technical guidance, industry skills and oversight. Perhaps the most critical element is whether a culture of compliance exists in the industry in the first place.

In that regard, many within the construction sector will tell you that BCar has, at the very least, heralded the beginnings of a cultural shift. Eoin Leonard is CEO of i3PT Certification, one of the country's leading assigned certification firms. He points out that since BCar was introduced, there has been enhanced due diligence from design and construction teams.

"Even the harshest critics of BCar would have to admit that the levels of debate, discussion and upskilling in the area of building regulations have been unprecedented," he says. "So too the sudden adoption of electronic reporting systems, quality management systems and the welcome reintroduction of clerks of works on construction sites."

He points out that BCar continuing professional development (CPD) sessions tend to be booked out, and that the industry has never been so engaged in this topic. "Liability is very real now. The level of scrutiny applied to technical submittals, benchmarks and site inspection has improved immeasurably."

Orla Hegarty, assistant professor at the School of Architecture in UCD, agrees that we have

seen some positives as a result of BCar. “I would say yes, there has been a change in the culture, we are now seeing some cultural awareness about compliance.”

That said, neither Leonard nor Hegarty believe that the system has gone as far as it could in terms of influencing change and protecting consumers.“It’s still self certification,” says Hegarty. “There’s no independent inspection system. We know from other sectors that there has to be a level of independence in inspections or it doesn’t work. That’s true of any industry, whether it’s food safety or nursing homes or banking.”

Eoin Leonard points out that for the certifier role to work, there has to be impartiality. While many clients and developers can and do hire independent certifiers, they aren’t required to. “As it is, designers or builders can sign-off on their own buildings, and a handful of the country’s largest design firms continue this practice. This would not be deemed permissible in many other countries in the developed world.”

Critics also point to the fact that as far as consumer protection goes, the system is deeply flawed. By assigning liability to a certifier, the impression is given that homeowners will have recourse if things go wrong. But that recourse can only be activated through the courts – making the process expensive, unwieldy and uncertain.

While certifiers are obliged to have public liability insurance, the nature of building work is that defects may not emerge for years, by which time the certifier may have ceased to practice, meaning that his insurance will have lapsed, leaving the consumer with no realistic means of redress.

While the Irish system relies on a wholly privatised system of control, building control in the UK relies on a mix of private sector firms and local authority inspectors. Local authority building control officers, or private ‘approved inspectors’, make routine visits to site, ensure the building complies with regs, and issue a compliance certificate on completion.

In England and Wales, all local authority building control departments are members of Local Authority Building Control (LABC) which operates a warrantee scheme that covers homeowners against defects that occur after the first two years. Generally speaking, within that first two year period, the builder is responsible for dealing with any defects that arise.

While many critics of the Irish system defer to the UK system as superior, it is not without its faults. In recent weeks, it has emerged that the National House Building Council (NHBC) – which provides around 80% of the warranties in the UK – pays millions of pounds a year to building contractors. The NHBC is a non profit organisation, and has defended its actions, liking the ‘premium refunds’ paid to builders to the no-claims discounts that you find in motor insurance. The revelation has however raised concerns over the impartiality of the organisation and renewed calls for the setting up of an ombudsman for new homes.

Nor does the UK system ensure universal compliance. At an event organised by the Green Register in June, ventilation consultant Ian Mawditt presented findings from an as yet unpublished AECOM-led study for DCLG on the installation and performance of ventilation systems in almost 90 UK new builds. They uncovered a startling range of problems, including poor air quality, a lack of commissioning of systems, and insufficient flow rates in fans. Only three of the homes surveyed had large enough vents and fans to meet Part F of the building regs, which covers ventilation. “Levels of compliance are very low, and there needs to be a response,” says Ian Mawditt. “It’s not just a question of blaming building control. It’s an industry-wide problem, and one that government needs to review.”

While the UK system is far from perfect, it does seem to have avoided two further issues that complicate the Irish system. The first is complication itself.

Orla Hegarty in UCD says that the administrative burden of the system is very high. “The sheer amount of paperwork, if it’s done correctly, is very heavy and the outcome of that is that the people who are trying to be diligent and do it correctly can’t compete with those who are not.”

That ambiguity leads to the second major issue – cost. Some within the industry suggest that certifying a single building will cost up to €27,000. Others say it’s less than 10% of that.

Hegarty says that she is constantly asked that question, how much does BCar actually cost? “Is it two grand or twenty grand? Everybody is giving us different figures, and none of them are wrong. If you take it to the letter, and do everything correctly, it is twenty grand on the cost of a house.” (As of September 2015, following protest from self-builders, the Irish government has allowed those building their own home or extension to opt out of BCar).

She points out that because in theory you must log every material that comes into the house, the costs are potentially astronomical. “But the market just won’t bear that. We don’t have enough people in the country to do that level of inspections so the market has decided what seems reasonable.”

This of course implies an uneven application of the standards across the board. In the context of house building to come, it’s hard to see how the system can protect home owners – as well as all the other stakeholders – from the kinds of defects that have dogged the residential sector since the boom years.

On the subject of consumer protection, one suggestion advanced by many within the industry on both sides of the Irish Sea centres on latent defects insurance (LDI). What’s different about LDI is that it offers ‘no fault’ protection to homeowners against serious structural defects. You don’t have to go to court and pin the blame on anyone to get the problem remedied. LDI is compulsory in France, but is less common in the UK and almost unheard of in Ireland – in part, says Eoin Leonard, because underwriters are wary of our uneven reputation in relation to residential construction.

Finally, Dublin-based architect Mel Reynolds asks a simple question. In remedying what everyone agrees is a flawed building control system, is there a role for the passive standard?

“This isn’t a brand,” he points out, “rather it is building physics, branded. To achieve certification, a rigorous process of BIM performance modelling is undertaken at the outset, and then the certification process involves stage inspections, detailed photographic records and then independent audit of the revised BIM performance model on completion.”

In addition, airtightness testing results are only valid when completed by an independently certified tester, and many products have been independently performance audited by the Passive House Institute. Certifiers must have completed specialist training, and skills are maintained by a mandatory level of CPD required every year. It is, Reynolds points out, a well-thought out, independent system for performance testing and certification. Why, therefore, do we need to invent the wheel?

“So many in the industry are puzzled as to why the Irish government continues with a more expensive system of building control administration that delivers extra cost and delays, no additional consumer protection and no performance gain. Passive house is a system of audit that is a proven international standard, is cost-effective and more importantly is independent. Surely it merits further scrutiny by the department. Surely it’s better than self-certification.”

(below) Oxgangs primary school in Edinburgh, one of 17 PFI schools in Scotland shut down due to potentially fatal safety defects. (opposite) Priory Hall, which has since been renovated, one of Ireland’s most high profile building control failures.

Photo: Wullie Marr/Deadline News

INTERNATIONAL SELECTION

Photos: Meritxell Arjalaguer

Spaceship Home, Madrid

Designed by Spanish architecture firm NOEM, specialists in low energy timber structures, the striking and unusual ‘Spaceship Home’ was built for a filmmaker eager to make the most of the panoramic views from his plot in the northern suburbs of Madrid. A passion for the cinema, a desire for home automation and, clearly, a love of sci-fi all informed the design.

The 120 square metre house was elevated on a metal frame four metres above ground level to maximise the views, with a large terrace looking out over the surrounding landscape. But once this ‘spaceship’ form was established, client and architect were inspired to continue the sci-fi theme. “He basically told us he wanted a mother ship,” architect Pol Guiu told Dwell magazine.

Clad with lacquered galvanised steel, the Spaceship Home was constructed from three prefabricated timber frame modules. These arrived almost completely finished from the workshop, and were then assembled on-site in just one week to create the finished airtight structure. In the finished dwelling, one of these modules houses all the building services, while the other two house the living spaces and large glazed façades.

Continuing the space age theme, the occupants can control the house’s lighting, temperature, security, heat recovery ventilation and even the audio system from two iPads, which are docked in Star Wars-style control panels, one of the house’s main design features. The front door is also designed to open out-and-across with a pressurised, spaceship-type sound. Access is via a restored and modernised airplane staircase, which once belonged to a Spanair plane.

And while the house isn’t passive certified, its demand for space heating happily meets the criteria for a passive house (at 14 kWh/m^2/yr) — which, you could say, is fairly space age too.

Photos: Reto Guntli

Fox Hall, Hudson Valley, New York State

Fox Hall is the stuff of American cabin dreams — a rustic, certified passive house set on a 75-acre wooded property in New York's Hudson Valley, serving as a private retreat for its owner.

"The client had an emotional connection to the land – he had family in the area – and a deep commitment to sustainability," says Alan Barlis, principal of architects Barlis Wedlick." He was looking for a modern retreat from the city, a place to relax alone or with friends, that considered conservation of the land and energy use at every turn."

The retreat features the main passive house, with its screen porch tower and sauna, a small garage with a green roof, a natural outdoor pool — filtered entirely by plants and organic systems — and a 19th century barn, which was physically moved from a different plot nearby.

"Our client wanted a relaxed, low-maintenance retreat, appropriate for entertaining," says Barlis. "We accomplished this in part by separating the home and barn — which is the centre for entertaining — and using simple, durable materials for interior and exterior finishes."

The main residence is constructed from polystyrene-filled structural insulated panels, heated by an air-to-air heat pump, and ventilated with a Zehnder heat recovery system. It is also passive house certified by the Wicklow and New York-based Passive House Academy. Meanwhile the barn was also designed to be have net zero energy consumption, with a solar PV array on its roof.

Barlis says: "The home was sited in a rather wooded portion of the site because we wanted to open the house to the views of the woodland. Wooded sites and large windows can be considered big challenges for the passive house standard. But by balancing all the principles of energy-conscious design, we were able to meet the standard without compromising the client's design goals and aspirations."

Want to know more?

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The digital magazine is available to subscribers on www.passive.ie

Photos: Katie Lee

Our first 18 months in a passive house

In the summer of 2015, **Cheryl Hitchcock** and **Dudley Thompson** moved from an energy-hogging Victorian home into a new timber frame passive house in Cumbria's Eden Valley. Below, they give a frank account of what their first year and a half in their new home has been like — and reveal how shockingly low their energy bills are.

Up until 2014, we were living and working in a large Victorian end of terrace house in Kendal, Cumbria. This meant keeping a large old property warm all day, every day. And despite all attempts to improve its energy efficiency (including roof insulation, double glazing, door and window seals) the annual energy consumption from a combination of gas and electricity was 44,000 kWh. The carbon footprint of the house was around eight tonnes.

But we wanted to spend less time working, and we also wanted to downsize and find a house that would use far less energy. Having spent some time house hunting, it became clear that even buying a new build was not going to provide the energy efficiency we were looking for, so we decided to build our own home. Further research led us to the passive house standard.

We had seriously underestimated the problem of finding a site to build on, but we eventually bought a south facing plot in Crosby Ravensworth, a small village in the Eden Valley. When a stoneworks in the village closed down, the locals formed a community land trust to purchase the site. The trust built twelve affordable homes, financed by the sale of eight self-build plots.

We worked with architect Andrew Yates of Eco Arc to design our new home, and the builders moved on site in September 2014. In May 2015 we moved in, and we achieved our passive house certification in August of that year.

So how successful have we been in reducing our carbon footprint— and what is it like to live in our passive house?

First, the energy bills. The area is not connected to mains gas so our house is essentially all electric. Over the year ending October 2016 we used a total of 1,870 kWh on heating, domestic hot water and cooking. There was a small contribution (estimated 100 kWh) to space heating from our wood burning stove. This results in CO_2 emissions of 0.73 tonnes (based on figures published in Passive House Plus of 391g CO_2/kWh for the UK grid). Our total electricity bill for this year, including heating and all appliances, was just £340.

Over the same period, we generated 4,300 kWh of electricity from the 4kW solar PV installation on our south facing roof. Our feed-in-tariff payment was £680. So, we have reduced our home-related carbon footprint by over 90%, and we are £340 in credit over the year.

The performance has exceeded our expectations, and suggests that the Viessmann air source heat pump is working very effectively (we hope to install a monitoring system to gather more data on the heat pump this year). We also receive £274 a year in Renewable Heat Incentive payments for the heat pump.

The house is light, airy, calm and comfortable. It's very quiet, the air quality is good and there is little temperature difference from room-to-room. We had visitors recently who are considering building a passive house. They were particularly struck by the good 'feel' of the house.

We really notice the contrast in comfort levels when we visit friends in 'ordinary' houses. It's interesting how quickly you forget how cold houses can be, and how the temperature changes from room to room. Before we built our passive house, some friends commented that they like living with a temperature difference – but once they spend time in a well-insulated passive house, their views seem to change.

People have also commented that they think we have underfloor heating, because they can wander around barefoot and the floors feel warm. It's amazing what a lack of draughts can do. (Cheryl also comments that she likes being able to wear skirts in winter without her legs and feet getting cold.)

The house is brilliant on bright, frosty, winter days. The sun shines through the large south facing windows, warming the house up to around 21C without the need for heating. The house stays warm until it gets dark. Then we throw a few logs on the wood burner, and that keeps us warm and cosy. The stove flue warms our upstairs sitting room, where we watch TV later at night.

One consequence of a warm, draught free house is that, even though we monitor external temperature, it's hard to gauge how cold it is outside. We sometimes find ourselves going out of the house, then coming back to put on more clothes. As the graph shows, the temperature remains remarkably constant despite changes in the outside temperature, although it has been a mild winter.

The house is great for drying washing indoors, which is a real bonus in Cumbria. We simply hang wet clothes on a clothes rail, and most things dry overnight. This also helps to increase the humidity in the house.

Although we have a brise soleil to provide summer shading to the ground floor, the planners rejected our design for an overhanging roof, so we were worried that the house might suffer from overheat-

ing, particularly in the south facing main bedroom.

So far, this has not been a problem. By venting the windows at night, the bedroom has remained comfortable and the house has only topped 25C on a few days over the summer. If it becomes a problem in the future, we could move to a north facing bedroom on hot nights, or investigate adding some form of shading.

People often ask us what we would have done differently if we were starting again. Something we didn’t think of at the design stage is that there’s nowhere in the house to keep food and drink cool. We don’t want to keep all our vegetables, fruit, beer and wine in the fridge.

It would be great to have an old fashioned pantry – somewhere outside the thermal envelope but not exposed to frosts. At the moment, we keep our vegetables in a cupboard in the porch, but it’s not large enough for the beer, and we’re not sure whether it might freeze out there.

The stove was a ‘nice to have’ that we really wanted – partly as a warm focus to the living room, but also as a back-up if the electricity grid fails. However, it was not without its difficulties, and there was a point where we thought we would abandon it. The flue was expensive and hard to source, and getting the stove to be sufficiently airtight was a challenge.

But now it’s in, we’re very pleased with it, particularly when we come back after a holiday. The low temperature radiators take a while to warm the house up, but throwing a few logs in the stove raises the temperature quickly, as well as providing a welcoming glow.

We’ve now settled into life in our passive house. Although we’ve reduced our carbon footprint dramatically, we were concerned about the increase associated with moving to a village with no public transport. To help offset this, we have recently bought

a Renault Zoe all electric car, which we are really enjoying. In addition to the conventional 7.5 kW home charge point, we have installed one that enables us to charge at around 3.5 kW, so we can make good use of our solar generation.

In the future we hope to gather more data about the performance of the house. We've started using an Emonpi to monitor our electricity use and solar generation. We want to extend this to monitoring the efficiency of the heat pump.

We also use a Netatmo weather station to monitor the temperature, humidity and CO_2 levels externally and in the house. During the winter just gone, it showed indoor humidity remaining constantly between 40% and 60% (the ideal range) and CO_2 between 368 and 800 parts per million (well under the recommended maximum of 1,000).

Once the technology has matured a little, we intend to buy batteries so we can store electricity generated from the solar panels, and also allow us to be less reliant on the grid. Overall, the house is brilliant. We have spent years living in old properties and enjoying their architectural features. But now we look at them and see cold, draughty places that cost a fortune to heat and maintain. If we ever decide to move again, it will have to be to another well-designed passive house, or something very similar.

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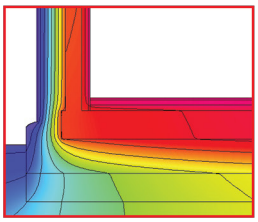

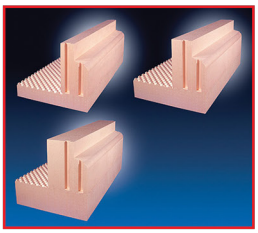

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SELECTED PROJECT DETAILS

Clients:
Cheryl Hitchcock & Dudley Thompson

Architect: Eco Arc Passive House Architects

M&E engineer: Alan Clarke

Main contractor: B&H Construction

Timber frame: Eden Insulation

Civil & Structural engineers:
Tweddell & Slater

PHPP & passive house design:
Alan Clarke, Eco Arc

Mechanical contractor: Eco Heat

Electrical contractor:
Westmoreland Electrical

Passive house certifier: Warm

Airtightness tester: Aldas

Wall & roof insulation: Eden Insulation

Wood fibre insulation:
Ecological Building Systems

Floor insulation: Isoquick

Airtightness products:
Ecological Building Systems

Windows & doors: Ecohaus Internorm

Heat pump:
Thomas Armstrong Renewable Energy

Wood burning stove: Morso

MVHR: Green Building Store

Solar PV: SunDog

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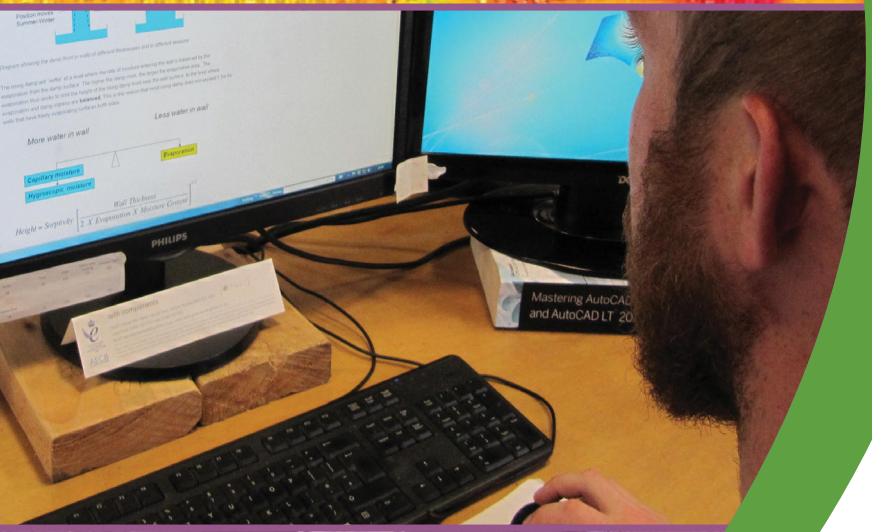
(clockwise from top right) The Eden Insulation timber frame panels before being brought to site; Durélis vapour block board, fitted internally to the panels, provides airtightness and vapour control; internal airtightness taping around windows; pro clima Solitex Fronta Humida membrane installed over the timber frame structure, which was further protected by an external layer of blockwork; erection of the timber frame, with the first panels being lifted into place; the Isoquick insulated foundation system eliminates thermal bridges between the ground floor and walls.



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PROJECT OVERVIEW

Building type: Four-bedroom, two-storey detached house, timber frame with external rendered blockwork. 135sqm treated floor area.

Location: Eden Valley, Cumbria

Completed: May 2015

Passive house certification: Certified

Space heating demand (PHPP): 12 kWh/m^2/yr

Heat load (PHPP): 8 W/m^2

Primary energy demand (PHPP): 101 kWh/m^2/yr

Airtightness (at 50 Pascals): 0.3 ACH

Measured energy consumption: 1870 kWh (Oct 2015 to Oct 2016)

Energy bills: Electricity £340 (same period)

Ground floor: Engineered oak floorboards on 250mm concrete slab, on 250mm Isoquick proprietary interlocking insulation, with 150mm wide insulation upstaged to edge of slab. Visqueen radon membrane below slab. *U-value:* 0.14 W/m^{2}K

External walls: Acrylic K-Rend render on 100mm recycled aggregate concrete blockwork, on 50mm cavity, on Pro Clima Solitex Fronta Humidia breather membrane, on 40mm Gutex Multitherm wood fibre insulation, on 300mm Finnjoist I-beam studs at 600mm c/c & fully insulated with Thermofloc cellulose insulation, on 12mm Durélis vapour block board, on 50 x 50 battens to form service void insulated with 50mm Knauf glass wool insulation, on Gyproc plasterboard internal lining with plaster skim. *U-value:* 0.103 W/m^{2}K

Roof: Slate roofing on bob tail fink truss rafters at 600 c/c. 600mm Thermofloc cellulose insulation at ceiling level, followed underneath by 6mm Eurostand ceiling substrate board to underside of ceiling joists, on Pro Clima DA vapour control layer, on 25x 50 battens to form service void, on flat finished ceiling with 12.5mm Gyproc board. *U-value:* 0.067 Wm^{2}K

Windows: Internorm HF310 timber/aluminium triple-glazed windows with ISO spacers. Plus Internorm HS330 sliding doors to same spec. *Overall U-value:* 0.76 W/m^{2}K.

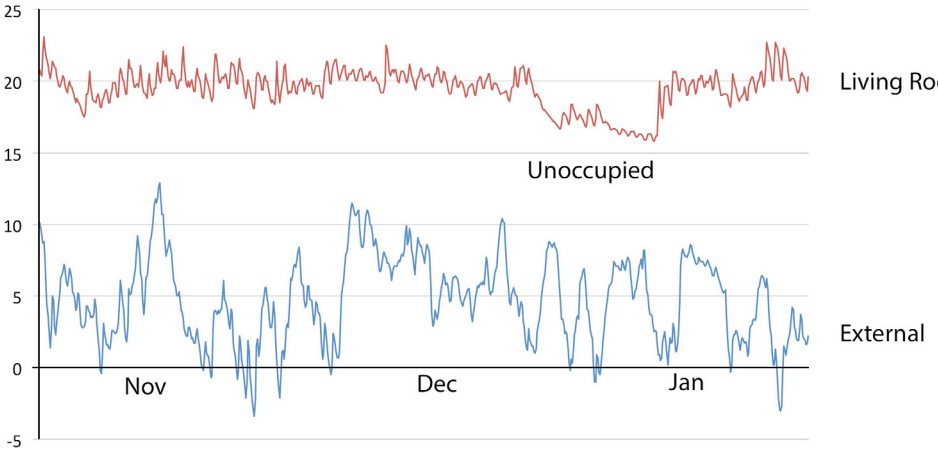
Heating system: Viessmann Vitocal 3kW air source heat pump with 170 litre domestic hot water cyclinder and delivering to low temperature Quinn Therm radiators. Morso S11 SERIES wood burning stove.

Ventilation: Paul Novus passive house certified MVHR unit with 93% heat recovery efficiency and 0.30Wh/m^3 electricity consumption.

Electricity: 4kW of Romag integrated solar PV tiles on the roof. Solarmax SM400P inverter linked to controller unit to transfer excess electricity to domestic hot water.

Green materials: Natural slate roofing, oak flooring, timber frame with FSC certified timber, cellulose insulation.

TEMPERATURE READINGS NOVEMBER TO JANUARY (DEG C)



"Our total electricity bill for this year, including heating and all appliances, was just £340."

“Much of the energy comes from having the kids running around in an airtight building, as they generate 4-5kW of power.”

ACTIVE LEARNING AT

Aberdeen passive nursery

A brand new passive-certified nursery at the University of Aberdeen provides the children of staff and students with a bright, warm and healthy space for learning and playing.

Words: David W Smith

Completed in August 2015, the £2million Rocking Horse Nursery on the University of Aberdeen campus is not only the first passive-certified nursery in Scotland, but also the first building of its kind in the Scottish commercial sector.

The significance of the nursery development was recognised by Professor Wolfgang Feist, director of the Passive House Institute, who visited the nursery in May 2016 to present its passive house certificate.

“Professor Feist doesn’t make too many visits to the UK so this was a real coup for the University of Aberdeen and Scotland,” says BMJ Architects project architect Siobhan Davitt, who now works for ADP: Architecture. “In his keynote address, he was very complimentary about the building.”

The location of the passive nursery building at the University of Aberdeen is significant. If the passive concept is to move from niche to mainstream in the UK, universities will certainly play a role in educating and inspiring the public.

“It’s become a talking point in Scotland and attracted visits from local authority teams, architects, planners, and nursery staff,” says Calum Proctor, project manager, University of Aberdeen estates section. “We’ve also had visits from the estates’ teams at other universities in Scotland, such as Edinburgh and Dundee, and the architecture students at Robert Gordon University. The university is keen to share its knowledge of passive house concepts as widely as possible.”

Further acclaim in the academic world came in November 2016 when the nursery won the large institution award in the built environment category of the Green Gown Awards, which recognise exceptional sustainability initiatives by British universities.

However, at the outset of the project in 2014, the university board was sceptical about the passive house standard. It had wanted BMJ Architects to take an innovative approach, and was open to the idea of a modern, sustainable structure replacing the old Hogwarts-style building, with its leaky windows and propensity to flood. But few of the members of the board knew anything about the passive house standard. Their enthusiasm was further dampened when the design team consulted passive house experts and were told it would inflate costs by 15 to 20%.

“The university took some convincing. We decided to go on a benchmarking tour with board members to visit educational buildings in the Midlands that had been constructed in a passive manner, including the Bushbury Hill and Oakmeadow primary schools, in Wolverhampton,” says Calum Proctor. “The children and teachers at those schools all love their passive house buildings and the trip helped to sell the project to the Aberdeen board.”

Building a passive structure was a leap in the dark. “Neither ourselves, nor the wider design team of KJ Tait, Cameron Ross

and WI Talbot, nor the client, nor the main contractor, Burns Construction, had any experience of passive house construction," says Siobhan Davitt. "In retrospect, this may have helped to make it successful. Everyone came to the project with fresh ideas and attention to detail."

Burns Construction employed an airtightness champion immediately for the project. Siobhan Davitt added: "On a steep learning curve, everything was double and then triple-checked and we had significantly more site inspections, discussions and client involvement than on a normal project. We started knowing nothing about passive house and ended up knowing a great deal."

Faced with so much that was unknown and unpredictable, the team faced many challenges along the way and worked closely with passive house consultants Future Komfort to resolve them. Steff Bell, chief consultant, helped the team with PHPP calculations, reducing cold bridging, and improving airtightness.

Siobhan Davitt added: "There was an issue with the fresh air ventilation in to the building. The building standards for schools mandates eight litres per second per person, but PHPP would only allow five litres. So to meet the building standards, we had to match eight, which increased energy consumption to meet the ventilation requirements."

The location of the site also posed technical challenges. The nursery had to be built on boggy ground in the Powis Gate area, on the periphery of the campus. "It's sitting on 14 metres of bog and we had to pile down to 19 metres," says Davitt. "There are also lots of services running through the site that couldn't be easily moved, such as the university CHP [combined heat and power] system. So there were lots of constraints before we even started."

The team also had to find a way to insulate the underside of the floor slab, and it proved tricky to dress the insulation around the complicated ground beams and pile caps. "We looked at refining those details as early as possible to make the design as simple and buildable as possible. But it added an additional level of complexity to an already fairly complex building," she says.

The phasing of the building threw up more conundrums during the 13 month build. The contractor's team ended up doing all the ground works in the winter, but there was a lot of rainfall, and the timber kits needed to dry out before the team could put up the airtightness layer. "Phasing was key. We tried to make up time by installing the screed, but the airtightness membrane had to adhere to the slab before the screed went on, which was challenging for the contractor," Davitt says.

In addition, the shape of the structure itself placed limits on the design process. When he came to visit, Professor Feist commented that he was especially impressed by the building's performance because it is harder for single-storey structures to achieve passive house certification.

"Though we made the building as condensed as possible, a more condensed and efficient two-storey volume would have provided greater efficiencies," says Davitt. "The nursery wanted to express the internal play space volumes as a contrast to the service spaces, which increased the surface to volume ratio."

Sourcing parts proved difficult because of unfamiliarity with passive house in Scotland. Many of the components had to be shipped in from Poland or Austria. "Getting them delivered and sorting out warranties was complex," Davitt says.

"Larger components, such as the windows and doors, had to be sourced from accredited passive manufacturers. The suppliers were nervous about fitting them as the level of airtightness had to be highly resolved before the orders went out."

Local timber frame manufacturer Scotframe prefabricated the closed panel, Val-U-Therm timber frame system used for the build. The wall and roof panels were in stud sizes of 235mm and 300mm respectively, helping these elements to achieve extremely low final U-values of 0.087 and 0.074 – the project's northerly latitude meant tighter specs were required to achieve the passive house standard – after further insulation was added. The timber frame structure was erected on site by Hybrid Build Solutions, and was integral to the project beating the passive house airtightness standard with a result of 0.48 air changes per hour.

The finished building is divided into two main areas around an enclosed, protected outdoor play-space. Part of the building is clad with larch, and part with a

(clockwise from top left) Insulation detail at the concrete pile foundations; spiral MVHR ducting and Intello vapour control membrane visible here at ceiling level; 65mm self-levelling floor screed, the timber structure exposed to the inside of the nursery; Sarnafil single ply roof membrane; larch timber cladding, Internorm aluclad windows and insulated reveals; Trad Safey Decking used to enable work on the double height ceiling; a series of Fakro quadruple-glazed roof windows, with U-value of 0.58, bring sunlight into the glulam-framed nursery space.

SELECTED PROJECT DETAILS
Client: University of Aberdeen
Architect: BMJ Architects
Main contractor: Burns Construction
M&E engineer: KJ Tait
Civil & structural engineer: Cameron & Ross
Passive house consultant: Future Komfort
Quantity surveyor: WI Talbot
Mechanical & electrical contractor: Sparks Mechanical Services
Airtightness testing: Stroma Technology
Larch cladding: Russwood
Chameleon panels: Rockpanel
Timber frame system: Val-U-Therm
Timber frame manufacturer: Scotframe
Timber frame builder: Hybrid Build Solutions
Airtightness products: Ecological Building Systems
Additional wall insulation: Ballytherm
Woodfibre insulation: Ecological Building Systems
Thermal breaks (Compacfoam): Partel
Windows & doors: Scotia
Roof windows: Fakro
MVHR system: Menerga, via SystemAir
Heat pump: Mitsubishi Electric
Solar PV: AES Ltd
Heating & lighting controls: West Coast Controls
Rainwater harvesting: Stormsaver Ltd

colour-changing cladding panel that shifts between green and orange. Sparkling particles in the materials react to light conditions.

"We created a captured garden enclosed by a wall and surrounded by established woodland, including two veteran 300-year-old trees," says Davitt. "The landscapes play an integral part with the external play spaces being an extension of the internal ones. Everything private and child-centred is contained within the captured section and everything public is situated outside that part. The children can run from play space to play space and get a real sense of autonomy."

The university has installed sensors to monitor the energy performance, and Calum Proctor says the energy savings have shown a huge drop. "Much of the energy comes from having the kids running around in an airtight building as they generate 4-5kW of power, he says. There's also an air source heat pump supplying underfloor heating, and a solar thermal system that contributes to domestic hot water.

Though the nursery is performing extremely well, there have been a few minor teething problems, and some overheating in the summer months, particularly in the kitchen. Proctor says: "It's not easy when the air outside is 23C and inside it's 22C. There's always the possibility that it will overheat by 10% a year [the maximum allowed with passive house certification], but we are working within those parameters. When it happens, there can be a slight discomfort, but nothing too great — and everyone involved loves the nursery," he says.

Want to know more?

The digital version of this magazine includes access to exclusive galleries of architectural drawings.

The digital magazine is available to subscribers on www.passive.ie

PROJECT OVERVIEW

Building type: 574 square metre single-storey nursery building at the University of Aberdeen

Location: College Bounds, University of Aberdeen

Completion date: August 2015

Budget: £1.9million

Passive house certification: Certified

Space heating demand (PHPP): 15 kWh/m²/yr

Heat load (PHPP): 14 W/m²

Primary energy demand (PHPP): 102 kWh/m²/year

Environmental assessment method: Breeam Excellent

Airtightness (at 50 Pascals): 0.48 ACH

Energy performance certificate (EPC): A-10

Y-value (based on ACDs and numerical simulations): 0.08 W/mK

Ground floor: Floor finish on 65mm screed, with underfloor heating pipes on 100mm expanded polystyrene insulation, on 200mm floor slab, on 2 x layers of 100mm expanded polystyrene insulation, on 50mm blinding sand, on Terram 500. *U-value:* 0.099 W/m²K

Walls: 8mm Rockpanel Chameleon cladding panels & larch timber cladding on 35 x 80mm treated timber battens, on breather membrane, on 60mm expanded polystyrene insulation, on 235mm deep Val-U-Therm timber cassette panels with 10mm OSB board each side & insulated with PU foam derived from vegetable oil, on VCL airtightness membrane, on 35mm air gap/ service void and plasterboard internal lining. *U-value:* 0.087 W/m²K

Roof: Sarnafil single ply membrane on 120mm PIR insulation, on Sarnavap sealed vapour barrier, on 300mm deep timber cassette panels with 10mm OSB board each side & insulated with PU foam derived from vegetable oil, on Glulam structure. 100 x 50mm framing between Glulam structure with 100 x 50mm timber framing and Ecophon Advantage E ceiling. *U-value:* 0.074 W/m²K

Windows: Internorm triple-glazed composite timber & aluminium windows, passive house certified. *Overall U-value:* 0.72 W/m²K

Roof windows: Fakro quadruple-glazed FTT U8 Thermo Pivot roof lights. *Overall U-value:* 0.58 W/m²K

Heating: Two Mitsubishi Electric Ecodan 14kW air source heat pumps supplying underfloor heating and DHW tank. 6.93kW AES Serpentine solar thermal array supplying 500 litre DHW tank.

Ventilation: Menerga Adconair 760501 MVHR unit. Passive House Institute certified heat recovery efficiency of 89%.

Ireland's largest passive house scheme

shows way to nZEB

At a time when the industry's under increasing pressure to deliver cost-effective, robust, low energy homes at breakneck speed, one new west Dublin project is leading the way – while picking off sustainability targets for fun.

Words: Jeff Colley

If there's one project that could break down mainstream resistance to sustainable building it's the 59 unit third phase of Durkan Residential's Silken Park housing scheme in Citywest – Ireland's largest certified passive house development to date. It's not hyperbole to say that this scheme may with hindsight be regarded as a key turning point in the normalisation of next generation sustainable building in Ireland. A development of rapidly built, affordable, all electric passive houses set up to adapt easily to net zero energy, the scheme is also the first by a private developer to meet the Irish Green Building Council's promising new Home Performance Index sustainability certification scheme. What makes all of this all the more remarkable – and subversive – is that the homes are being built of masonry, utilising local materials and local skills, but with a smart, methodical, lean approach to design and construction.

With homes being turned around to world class comfort, health and energy performance standards in a twelve week build schedule, Silken Park takes a disarmingly simple approach: single leaf hollow block construction sat on an insulated foundation system, the walls wrapped in a generous layer of high density Rockwool external insulation, with a sand and cement render internally acting as the airtight layer.

For passive house certifier Tomás O'Leary of Mosart, the fact that a well detailed wall integrating hollow blocks – which had unfairly been tarnished due to their role in an inadvisable yet widespread build-up with internal insulation – is an important breakthrough. "It basically proves that it's not the materials you use – it's how you use them," he says. "It's not what you have between your hands that counts – it's what's between your ears. You can keep using the system that you know and love, but just do it way better. Passive house is hard enough without changing the whole way you build a building."

Photos: Peter Moloney, PM Photography & Leon Farrell/Photocall Ireland

(above) The houses are constructed of single leaf hollow block walls finished outside with Rockwool's REDArt Silicone and BrickShield external insulation systems, including 200mm Rockwool semi-rigid insulation.

But phase three of Silken Park is no full stop. It's rather the latest point in a journey Durkan Residential have been on since brothers Patrick and Barry Durkan set up the company in 2003. The 55 unit first phase was built in 2007 to a high standard in terms of finishes, but built to the energy performance standards under building regulations at the time. When the new build market nosedived, the brothers teamed up with architect and sustainability consultant Jay Stuart to form Ecofix in order to to capitalise on the new market for retrofit, and external insulation in particular.

Stuart, the company's technical director, says Ecofix specialises in "cost-effectively building low energy, high quality external envelopes." According to Stuart, the company has accumulated invaluable experience and knowledge in its efforts to improve the existing stock – knowledge that can be applied to new build too.

"It's been a journey together working on retrofit for the last eight years – getting used to the idea of what's effective, what's cost-effective, and to trial ideas on relatively small contracts, and to be thinking about airtightness, thermal bridging and ensuring we get adequate ventilation.

Stuart describes Silken Park as a "great opportunity" as a clean slate to apply the principles that the company had been applying in retrofit. "Through our experience, we encountered many, many problems homeowners had with poor ventilation, condensation and mould, and lack of thermal comfort. Applying all of that experience to new build, Ecofix and Durkan Residential saw that we could achieve a high standard cost-effectively. That's the core message – ventilation, airtightness and thermal bridging. And I'd put ventilation before airtightness."

As previously reported in issue 18 of Passive House Plus, the company began to apply its learnings to new build in last year's 15 unit second phase at Silken Park, itself a laudable low energy project which featured essentially the same wall build-up, but with double rather than triple-glazed windows, a strip foundation system, demand controlled ventilation and condensing gas boilers. The project blitzed the airtightness target of under 2 ACH – nine of the homes came in at less than 0.534 ACH, and the worst recorded result was 0.812. The Durkans took note: passive house was within reach.

Nonetheless, Barry Durkan – who along with several other staff members has recently qualified as a certified passive house tradesperson – didn't take the decision to take on passive house – and Ireland's largest passive house scheme to date at that – lightly.

"It was a little daunting," he says. "The fact that we had phase two under our belts made it a little easier – we'd dealt with airtightness and external insulation."

He needn't have worried. The final blower door test result on the show house of 0.20 – coincidentally in both air changes per hour and $m^3/hr/m^2$ at 50 Pascals – is one of the best results Passive House Plus has ever encountered, in particular for a masonry building. It's three times lower than the passive house threshold, and no less than thirty-five times tighter than the backstop of 7 $m^3/hr/m^2$ under Irish building regulation, making a mockery of the state's targets.

To stretch credulity further, the sealing work was done by crew members from fabric contractor Ecofix who were experienced in external insulation, but had never done airtightness work before. But they didn't get there by fluke. The buildings were carefully detailed for buildability, toolbox training was delivered for site operatives by Barry Durkan, and renowned airtightness expert Roman Szypura of Clioma House – who had served as airtightness contactor on phase two – acted as airtight consultant.

According to Ecofix CEO Kevin Durkan, the team's formidable results were underpinned by decisions taken long before the project went on site. "It's because it was so well designed," he says. "It was very easy to follow, and doesn't take much to police it. We were going around the envelope to look for a pin hole to show the guys what a tiny leak is like at 50 pascals of pressure, to feel the wind coming through. We couldn't find one, other than the keyhole."

The end of terrace show house was no anomaly either: the two other smaller dwellings in the same block kept up the impressively high standards, clocking up results of 0.28 and 0.29, giving an average for the three houses of 0.24.

Rapid and methodical

According to Barry Durkan, the requirement to define the spec and build process early on in the Passive House Planning Package software is one of the key reasons the company is achieving a 12 week build schedule. "PHPP gives us a system approach to building. That's what attracted us in the first place. You can organise your labour, your men, so your procedures flow. You can get into really good detail in terms of planning. Because the model is done – there's no guess work anymore. Once the PHPP was done we knew exactly what we had to achieve. Our detailing was done. It affects all trades – block layers, carpenters, right through the spectrum. So we write into in the contractors' package what we expect from them. And we go into detail about airtightness."

He adds that the clarity of the process creates a good atmosphere on site. "Everyone knows where they're going. We've got good quality control." Barry Durkan also emphasises the decision to use construction software developer VRM's cloud based collaboration and invoice management platform Refurbify – which harnesses the ubiquity of smart phones to give site operatives evidence-of-use apps that track progress in real-time against planned works and specified products. "It's been very positive," he says. "Initially the operatives were sketchy about it because it required a bit more time, and evidence of each individual house. But once the first few houses were done, it just became part of the contractor's brief." Such a tool, he points out, is well timed to capitalise on the requirement to manage and record work inherent in standards such as passive house and Ireland's Building Control Amendment Regulations. "It's about getting everyone to buy into it – from professionals to contractors."

“There needs to be a rebate for this type of house – a reduction in terms of local contributions.”

(l-r) A site visit with Patrick Durkan, Department of Housing advisor Seán Armstrong, Minister of State for Housing Damien English and Electric Ireland general manager Paul Stapleton.

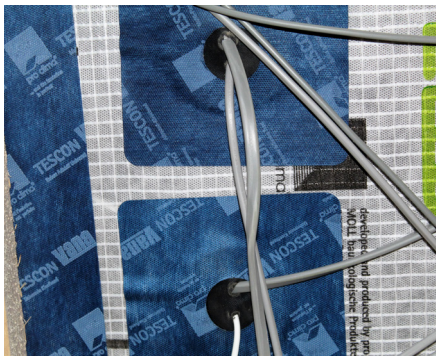
The evidence trail also played a key role in the project gaining Home Performance Index sustainability certification in spite of the decision to apply being taken when the project was well advanced.

Cost neutral

But what about cost? Durkan Residential commercial director Andrew Kinnear sheds some light:

“We did an independent review of our figures of a comparable house – standard block construction and timber frame regs compliant houses, with comparable finishes in terms of kitchen and finishes. It’s coming in cost neutral.” According to Kinnear, this is in large part down to a decision to start with a blank piece of paper and design from first principles. “Certainly historically, developers have looked at new regulations coming in, brought a consultant in and said: ‘here’s my house, what do I have to add to it to make it comply?’ As opposed to value engineering it.” He has a point. The prevalence of this kind of approach is reflected in the costing exercise the Department of Housing does in its regulatory impact analyses when introducing proposed changes to building regulations, where a typical house design is chosen, and the extra cost of ratcheting it up to the new standard is quantified.

While there have been numerous examples – many published in this magazine – of single dwellings built to the passive house standard within normal cost ranges, Tomás O’Leary points out the significance of commercially-minded house builders reaching the same conclusion. “It’s very encouraging that they’re delivering passive houses at cost parity,” he



(clockwise, from above) Barry Durkan’s own detail for an airtight attic hatch, a plywood box with a depth to match the 450mm attic insulation; exhaust and intake holes for the MVHR system, separated by a corner wall to avoid crossflow/contamination, sized large to allow a slow fan speed and quiet operation; airtight taping around Munster Joinery windows; sand and cement render to the blockwork internally for airtightness; airtight grommets around entry points for cabling.

says. “We now have two developers – the other being Michael Bennett – delivering passive houses at no extra cost. When it comes to larger development there really is no excuse. The cost argument is off the table. Move on. That’s no longer an issue.”

Durkan Residential managing director Patrick Durkan points out that going passive – added to the company’s own methodical approach – is helping to keep costs down. “Our design approach with every house of apartment we’re building takes the passive house design principles, he says. “By using PHPP to design, we build a really good house. We don’t need to add all of the extras. We’re sticking to our principles: externally insulate and make the envelope airtight. It doesn’t make it cost prohibitive – it’s just clever.”

Materials

Patrick Durkan explains that while this is the second version of this design, the company is “still trying to refine and refine” to reduce material costs without compromising on performance. “The less in, the more economic we can make the build cost.”

That can also mean cutting down on environmental impact, by utilising fewer materials. The use of single leaf walls of hollow blocks – which use some 30 to 40% less concrete than a comparable solid block, and are relatively quick to build with – is one example. The KORE Passive Slab is another.

Structural engineer Hilliard Tanner explains that the systems is essentially a continuous ring beam around the perimeter attached to the floor slab, with thickenings in the slab for load bearing party and internal walls. “In all projects, the insulated foundations are designed to take account of the ground conditions and the loads from the structure on them - which in our experience rarely happens for traditional strip footings.” says Tanner. Jay Stuart is a fan. “It’s a different conceptual approach to digging a trench and pouring lots of concrete to support the point loads or structural loads which are usually the external and party walls,” he says. “The thing about the Passive Slab is that it’s a floating foundation which instead of sitting on the ground is sitting on a layer of impervious insulation, sitting on stone.

This simplifies the build process and saves money. “You don’t have to dig trenches, you don’t have to cart away sub soil,” he says. “There’s a saving in everything you don’t have to excavate and cart away using diesel to landfill – which is also not a great thing.”

KORE claim that the system can reduce concrete use by up to 50% compared to a conventional strip foundation system, which means cost and environmental savings. “You know to the cubic millimetre how much concrete you need long before you arrive on site,” says Stuart. “And because the insulation is prefabricated and delivered, there’s virtually no waste on site. You’re not really cutting on site – other than services coming up through the slab.”

Stuart points out a health and safety headache is removed by migrating from conventional foundations. “You dig a trench. As soon as you dig that you’ve got a safety hazard. You then pour concrete into it up to a certain height. Then you build rising block walls up to the slab height. And you don’t usually back fill the trench until the rising walls are built up. So, during those four

(above, top to bottom) Installation of the Kore Passive Foundation system with EPS insulation beneath the slab and around the ring beam at the perimeter, eliminating thermal bridging through the ground floor, while minimising construction waste in the process – the off cuts shown here are from five houses.

The passive route to electric nZEB

Electric Ireland general manager Paul Stapleton explains why the state’s largest electricity utility sees a bright future for projects like Silken Park.

Electric Ireland is proud to be associated with the Silken Park Development, which brings the benefits of a fully future-proofed all-electric home to homeowners today.

Electric Ireland has a long record of providing customers with sustainable energy solutions and helping them to use less energy. Over the past three years, we have invested about €20million in this way, reducing customers’ bills by circa €50million or over 430GWh of energy, equivalent to the annual consumption of about 50,000 homes.

Climate change is the defining challenge of our generation. ESB, which Electric Ireland is part of, aims to lead Ireland’s transition to a low carbon economy, using our knowledge, skills and experience in our business, and that of our partners, to find the best route for society as a whole.

At Silken Park, we have worked with Durkan Residential to develop an “all electric home”. These homes have very efficient heat pumps to provide all the heating and hot water and they are pre-wired for electric vehicle charging. They are healthy & comfortable to live in, with low maintenance costs and very low energy costs – as much as 50% less than typical homes. They are emissions-free, so the air in the neighbourhood is clean and healthy to breathe. All of this comes for the same price as a normal house.

processes, until they're complete you have a trench – a safety hazard that you can trip up on. It's messy and the edges are irregular.

"With the Passive Slab all you're doing is adding layers of compacted stone. So it's a very safe, easy site to move around on at all stages of construction, carry materials, or run a wheelbarrow. And that speeds up all sorts of processes which you couldn't anticipate."

Passive House Plus visited the site in February for an industry launch event, wangling a lift in Stuart's Nissan Leaf EV. Had the houses been finished, Stuart would have been able to recharge his car on site: all 59 houses will come pre-wired for EV charge points. In fact electrical innovation is a theme of the project: the homes use Nilan Compact P units for all heating, hot water, ventilation and – if required – a small amount of cooling, via a combined exhaust air heat pump and heat recovery ventilation system. The roofs are designed to take the weight of a solar PV system covering the whole roof area.

While the houses are already set up to beat the government's nearly zero energy buildings target mooted for introduction by 2019, the addition of PV arrays would push them towards net zero. "At the moment we're going for net zero, not nearly zero," says Patrick Durkan." Nearly doesn't cut it in the commercial sector. You can't nearly make money. We're steaming forward to net zero. We need to integrate our houses with the grid. The last element of that is battery storage and the electric car. The house needs to become part of the grid, and part of that is the car. The car industry's going to evolve more in the next 15 years than it has in the last 100."

What's more the residents at Silken Park will have the chance to charge their EVs and run their heat pumps for free: utility provider Electric Ireland has recognised the significance of the project, and is offering the occupants of the 59 homes three years worth of free night rate electricity, provided they sign up to the company's new Pay as You Go package within three months of moving in.

The next step, according to Patrick Durkan, is to gather data from these homes, occupants willing, via a monitoring study in partnership with Electric Ireland, to share the learnings and inspire change – such as by showing the banks evidence that homes with such low running costs may warrant preferential lending terms. "We have spoken to one of the pillar banks. It's a little early for them. By taking big data to the financial institutions with Electric Ireland we hope to show that these people need less disposable income [to justify a mortgage] and are less of a default risk."

For Patrick Durkan, there's a clear route ahead to further refine specs, deliver more cost savings, and improve environmental performance. "I call it positive living," he says. "We want to reduce our reliance on local services and contribute to local infrastructure." This will involve ambitious measures to conserve water and reduce foul and run-off water, and therefore tread lightly on public infrastructure. "At the moment in certain counties I'm paying €5000 for water rates out of a total contribution of €20,000. That goes on to the price of a house," he says. "That should be €5000, but with less water coming in, and less foul going out."

With one eye on a future where sites are self-sufficient in terms of water supply and disposal, Patrick Durkan argues that council land zonings and development contributions structures could recognise and stimulate such innovation. "There needs to be a rebate for this type of house – a reduction in terms of local contributions," he says. "And that will be passed on to the consumer."

Patrick Durkan says Silken Park serves as proof that the common perception that being green means making sacrifices isn't always true. "I don't like the concept of green – tree hugging, putting on an extra jumper," he says. "I spend a quarter of my fuel, I have a better, healthier, more comfortable living environment, and we don't add to government fines for failing to meet our carbon reduction targets. The benefits of this are actually immeasurable." Patrick Durkan adds that the industry and parties invested in solving the housing crisis – councils, housing associations and politicians – need to take note of what is achievable and possible today.

The tens of thousands of families – this writer included – gripped in the turmoil of a housing crisis would be well served if Durkan's words are heeded. There is considerable risk inherent in engaging in a rush to build quickly, when faced with a skills gap, and an industry is having to work out how to meet dramatically improved energy performance targets under national building regulations. Low energy buildings behave differently, and the industry's broad failure to get to grips with building physics means that some considerable risks – overheating, poor indoor air quality and both surface and interstitial condensation, never mind failure to deliver anticipated energy savings – won't be discovered until tens of thousands of buildings have been built, and the damage is done. Considered, proven approaches – and the 25 year old passive house standard stands out uniquely as a safe approach that is tried and tested, cost-effective, and delivers extraordinary comfort and energy performance – must be central to our plans. If the industry is willing to build upon the improvements in knowledge and workmanship evident in recent construction output, it has nothing to fear from going passive.

"It hasn't just happened overnight," says Barry Durkan. "We have put a lot of work into this. The mindset has to start from the top down. There has to be that desire to change. It needs to happen now. There's no quick fix solution. We're doing this because we think it's the right thing to do."

Jay Stuart has a seductively simple message: "Keep it simple. Focus on a few things," he says. "We're always researching and investigating alternative products and ways of constructing. We know there are still things we can do to increase the value and reduce the cost. It's part of a journey, with continuous improvement, and we're getting to places we never thought we'd be."

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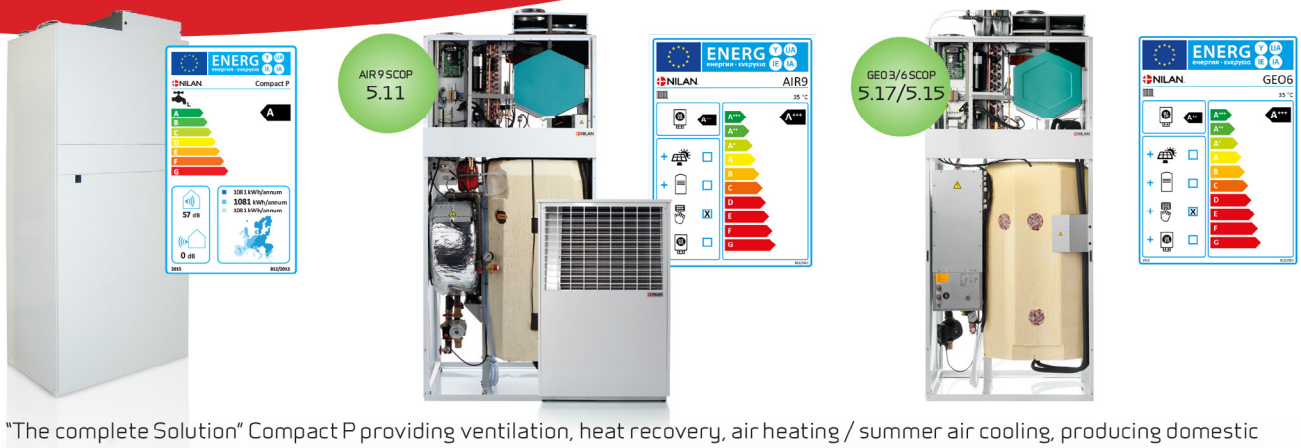

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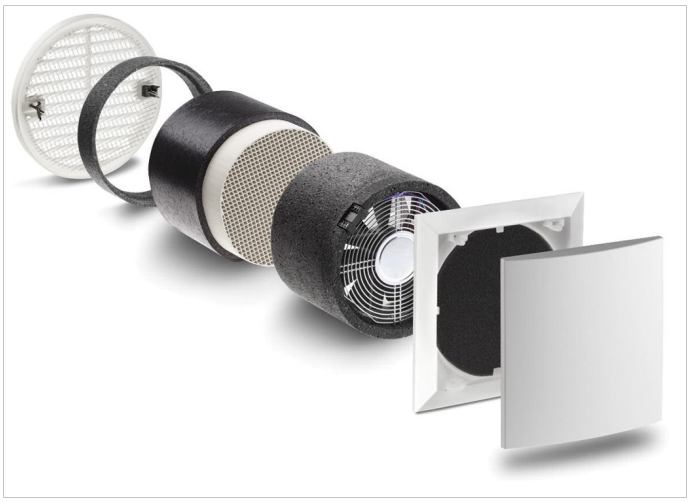

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Civil & structural services: Cronin & Sutton Consulting
Civil engineering contractor: Cowman Civil Engineering
Insulated foundations consultant: Tanner Structural Design
Energy consultant: Low Energy Design
Mechanical contractor: Mowlds Heating and Plumbing
Electrical contractor: JP Byrne & Company
Airtightness testing & passive house certification: Mosart
External wall insulation: Rockwool
Building envelope & airtightness contractor: Ecofix
Roof insulation: Knauf, via Heiton Buckleys
Insulated foundations: Kore
Airtightness membranes and tapes: Ecological Building Systems
Airtight sealant: Passive House Systems
Windows & doors: Munster Joinery
Heat pump/MVHR: Nilan Ireland
Fit out: Bedroom Elegance
Roofing supplier: Roadstone
Roofing contractor: Neal Brennan
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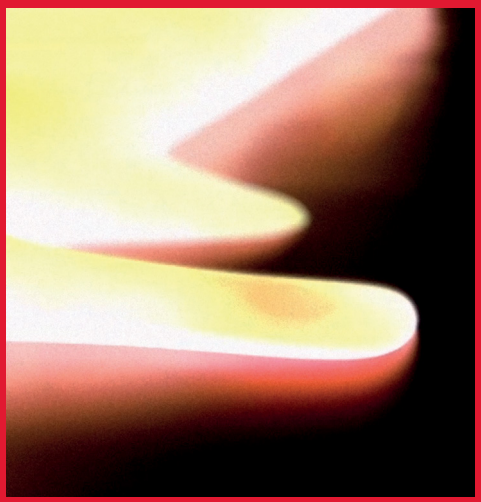

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PROJECT OVERVIEW

Building type: Phase 3 of a private development, consisting of a mix of terrace, semi-detached and detached houses.

Twenty-four Type B 2-bed terraced/ semi-detached houses (84m^2), twenty-nine Type A 3-bed terraced/semi-detached houses (109m^2), five Type C 4-bed semi-detached houses (120m^2) and one Type D 4-bed detached (126m^2).

Location: Citywest, Co. Dublin

Completion date: To be completed April 2018

Budget: N/A

Passive house certification: All 59 houses to be certified.

PHPP/DEAP figures below are for three-bedroom, semi-detached units.

Space heating demand (DEAP): 16.22 kWh/m^2/yr

Heat load (PHPP): 8.89 W/m^2

Primary energy demand (PHPP): 115 kWh/m^2/yr

Energy performance coefficient (EPC): 0.294-0.313

Carbon performance coefficient (CPC): 0.304-0.326

BER: A2 (47-49.6 kWh/m^2/yr)

Airtightness: 0.2 – 0.29 ACH at 50Pa

Thermal bridging: By using a fully insulated foundation and floor system and EWI on solid block we have designed a thermal bridge free envelope. *Y-factor:* 0.02

Ground floor: KORE Insulated Foundation and Slab system. *U-value:* 0.12 W/m^{2}K

Walls: Single leaf 215mm concrete block wall finished externally with Rockwool's REDArt Silicone and BrickShield external insulation systems, including 200mm Rockwool semi-rigid insulation and 15mm sand/ cement render internally as the airtight layer. 16mm electrical services zone and 12.5mm plasterboard on dabs finished with wet skim coat plaster. *U-value:* 0.16W/m^{2}K

Roof: Roadstone black concrete Donard roof tiles, on 50X35mm battens, followed underneath by breathable Pro Clima Solitex underlay, attic trusses as designed by Harmony Timber Engineering fully fitted with 200mm Knauf Ecosse insulation, fitted between joists with another 150mm criss crossed over, with a final layer of 100mm crossed over. Solitex membrane tacked to underside of ceiling rafter and taped at overlaps and wall junctions. 25mm battens countersunk into rafter for service void. 12.5mm plasterboard ceiling and skimmed internally. *U-value:* 0.08 W/m^{2}K

Windows: Munster Joinery passive certified windows. *Overall U-value:* 0.8 W/m^{2}K

Heating & ventilation system: Nilan Compact P unit, Passive House Institute certified, combining mechanical heat recovery ventilation with hot water generation and storage. MVHR heat recovery efficiency at 75%.

(top inset) Pictured handing over the HPI cert are (l-r) IGBC chief executive Pat Barry, South Dublin County Council leas cathaoirleach Martina Genockey and Patrik Durkan.

Beyond passive, to overall sustainability certification

Not content with being Ireland's largest certified passive house scheme, Silken Park is also the first scheme by a commercial house builder to achieve the Irish Green Building Council's new Home Performance Index sustainability certification. IGBC director Pat Barry explains how it got there.

The fact that the Silken Park homes are offered at starter prices goes to prove that quality and sustainability are not about adding cost, but simply about the choices, and the skills of the homebuilders. IGBC was delighted to award the first Home Performance Index certification for a private development to Durkan Residential.

The Home Performance Index takes a more rounded look at sustainability, looking beyond just energy efficiency to assess other key quality and sustainability criteria that matter to the home buyer and the planet. With Silken Park, passive house certification meant some of the indicators within HPI were deemed to be met but sometimes for slightly different reasons, the designed ventilation system is required principally to guarantee good indoor air quality rather than energy efficiency. The homes also met other HPI requirements such as water efficiency and daylighting, together with achieving the required score based on assessment of access to amenities, public transport, acoustic performance and responsible use of land.

We were impressed at Durkan's attention to documenting the construction process which meant we could quickly turn around certification based on core criteria. Had we delved further into non-core criteria we are sure we could have awarded a higher level of certification. The scheme also showed great innovative thinking such as the wiring for the future PV and electric cars.

Within the HPI airtightness is a key indicator of on-site quality control so the figures achieved on Silken Park, destroys the argument that Irish builders lack the ability to build as well as anyone in Europe. It proves that if we start measuring things, and setting quality benchmarks then the competitive innovative instinct rapidly sets in.

The construction industry is dynamic so practices, skills, innovation, and building components are constantly evolving and with the right drivers, are well capable of moving quickly well beyond minimum compliance to true excellence. It is best to measure against what the better players in the market like Durkan Residential can deliver rather than relying on backstops against the worst.

The Home Performance Index is aiming to do just that, gathering and sharing the data on best practice for a full range of indicators from airtightness to lesser known benchmarks on waste management, sustainable procurement, ecology, water, and embodied carbon. Silken Park gives us hope that the construction industry is capable of tracking, improving and competing to true excellence over the next five years.

The carrot for the developer will be the recognition by home buyers and eventually a better price or faster sale. Why hide your light under a bushel if you have the documentation to prove that you build better than the rest? For this reason IGBC has now launched the Home Performance Index platform where home buyers can skip the agents' guff and look directly for quality third party certified development like Silken Park.

For more information on the Home Performance Index see **www.homeperformanceindex.ie**

A GREEN BUILDER'S *dream green home*

Photos: Kelvin Gillmor

This is what you get when one of Ireland's most experienced low energy builders creates a home for his own family, with help from one of the country's foremost ecological architects — a modern and elegant passive house that pays detailed attention to sustainability at every turn.

Words: John Hearne

When Niall Dolan set out to build his own house, the results were always going to be interesting. Dolan set up GreenTec Ecological Homes Ltd in 2002, and ever since then, he's been at the forefront of sustainable building in Ireland. Based in Craughwell in south county Galway, the home Dolan built for himself, his wife Mary and his two children is a showcase of everything he has learned over the past 15 years.

One of the fundamental aims of the build was to create an exemplar project in sustainable building for one-off rural houses. And what the Dolans have ended up with is a passive, nearly zero energy building that makes abundant use of sustainable, healthy materials.

It's also a beautifully designed home, and indeed, Dolan and his architect Miles Sampson put lots of time into making sure the finished house was both traditional yet contemporary. "I knew that Niall would be building the house to the highest standards in sustainability and construction quality," says Sampson.

The layout of the timber frame house takes its inspiration from the traditional farmhouse cluster, where home and outbuildings enclose a central courtyard. It also respects the site's traditional boundaries of dry limestone walls and mature trees, all of which were retained.

But just because the project had such an experienced contractor and client didn't make it easy. For Niall Dolan, the central challenge of the project lay in simply getting the time to build the house in the first place. He explains that he struggled continually to find time between his clients' projects to get the work done.

"This wasn't a speedy build," he says. "I did the foundation, then the frame the following year...and so on. It was very stressful because the other houses I was building took priority over mine. I was always on the back foot."

Spreading the work out over such a long period caused quite a few complications. Take the wood fibre external insulation, a product that neatly represents the material choice across the project. The Dolans were keen to make sure that almost everything they used was natural. But by specifying wood fibre external insulation, the project took on a certain level of risk.

Niall explains that you need nearly five weeks of dry weather, first to fit the insulation, then for rendering. That would be challenging in any circumstances, but to find that block of time in between his other commitments was especially difficult.

"It was tough," he says. "We just managed to get those five weeks in September 2015. If I'd missed that slot, I'd be a full year behind – there's no way I'd be in the house now. When I'm building houses for clients and there's wood fibre specified, I know I could lose my shirt on it because if the house starts at the wrong time, if there's a delay on widows and you run over, the project is suddenly months behind."

There were no such issues with the cellulose insulation specified for the walls. Over 11,000 recycled newspapers were used to create the insulation, which he chose not alone because it was a natural material, but because it compacts well and fills the entire wall void easily. But in order to deliver passive standard thermal performance, a deeper build up is necessary than would be required with a synthetic insulant.

Niall was also keen to find windows which did not use petrochemical-based insulation in the frames, and sourced a passive certified unit from M-Sora. The frames are made entirely of wood, and feature a patented technology which gives a passive standard U-value using air alone as an ▶ insulator in the frame.

It's interesting to note that specifying all timber, instead of aluminium-clad windows,


“The heat is so consistent.
You don’t have to worry about
closing doors or drafts.”

reduced the spend on what is one of the biggest cost elements of any passive build by a full €10,000. By going with all timber units, Dolan was able to both maintain the traditional aesthetic he wanted for his house, and to keep faith with natural materials. The downside of course is the need to maintain the timber.

The use of external insulation actually helps out quite a bit here however. The wood fibre extends over the frames of the windows, reducing the surface area exposed to the elements. Moreover, Dolan explains that in his last house, the choice of an all-timber unit worked out really well.

“I got seven years out of them before I had to repaint, and it cost about €700 to do the job. So I did the maths. If you need to repaint every seven years, it’s a long time before you get up to ten grand.”

He had anticipated that a rooflight, which Sampson specified for the entrance area, would have to be specially made to meet passive house standard. But at a trade show in Germany, Dolan came across a passive certified quadruple-glazed unit from Velux that fitted the bill perfectly. The first of its kind in Ireland, it’s solar powered, and can be opened remotely.

Staying with solar power, Sampson was able to position the house to make maximum use of passive solar gains, while still retaining the mature trees. The back of the house faces south, and features a stepped profile to ensure that kitchen, dining room, sitting room and playroom all get equal sun. This elevation has a modern feel, with lots of glazing, while the north-facing front of the house has a far more traditional design, with small, dispersed windows looking onto the public road.

“The design challenge was to create a home that reflected the different aspirations of both Mary and Niall,” says Sampson. “The solution of using a more traditional architectural language facing the public road also tied in nicely with passive house certification allowing for smaller windows on the north side of the house.”

The flat sections of the roof will be planted with sedum, while the pitched roof has been fitted with a 4kW integrated PV array. The sedum area was sized by the architect to offset the amount of carbon used in the making of concrete for the foundations, thereby delivering a zero carbon build. In addition, the roof is wired to take a further 6kW of PV if required.

Dolan is also planning to source a battery to allow him to store power and thereby reduce his reliance on the grid at times when the PV is not producing. He also plans to have enough energy left to charge an electric car.

The house is primarily heated by a Nibe air source heat pump, supplying underfloor heating on both floors. There’s also a gas-fire in the sitting room, where Dolan didn’t specify underfloor heating, to avoid any risk of overheating in a room with façades facing south, west and north.

With so much sustainable building experience under his belt, you would think airtightness would not have been a problem on the build. Under normal circumstances, it wouldn’t have been. Again however, the fact that the Dolans had to stagger the project threw up unforeseen issues. Typically, Niall says, airtightness is done in one fell swoop over a two week period.

“I was bringing lads in for a day here and a day there. They’d do one room, then I’d have them off on another job, and to be honest, that just doesn’t work. You need your head in the job, and if you leave it for two months then come back to it, it’s going to take you a while to pick up where you left off.”

Frequently, the build team found themselves having to redo work just to make sure that the passive target would be achieved. “They might have primer put on the floor, then a month later, they’d have to reapply it because there was dust in it.”

Dolan adds that Emmet Nee, who helped erect the timber frame – manufactured by Advanced Timber Craft, who have since rebranded as Kudos – helped keep the building’s airtightness on track. “Emmet always ensured the first fix airtightness was under control,” he says.

Dolan was also keen to ensure that any of the structural and performance elements of the build would not hinder architect Miles Sampson’s design flair. That meant, however, that a canopy extending from the back elevation created a particular challenge as far as airtightness was concerned, where ▶

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it met the thermal envelope.

The preliminary result measured by airtightness specialists 2eva.ie – 0.58 ACH – is just inside the 0.6 ACH passive threshold. Dolan expects this to improve further when the final test is completed, as much more sealing work has been done since.

One thing Dolan allowed additional time and budget for was slabbing the interior walls. Instead of conventional plasterboard, he sourced magnesium oxide board.This has the advantage of having a much better racking strength compared to conventional gypsum slabs. You can hang everything from kitchen units to TVs directly from the boards – which again are natural materials – without the usual need in timber-frame construction to incorporate a timber filler behind the wall.

But is it possible to quantify the impact of such an ecologically-minded spec? In the absence of a full life cycle assessment, there are some positive indicators. In very rough terms the use of the insulated raft foundation likely reduced concrete use by 40 to 50%. What's more, an extremely low carbon alternative to Portland cement – ground granulated blast-furnace slag (GGBS) from Ecocem – was used, including 50% of the 50m^3 or so of concrete used in the foundations, and 25% of the 17m^3 in the floor screeds. According to Ecocem's environmental calculator, the net effect is that seven tonnes of CO_2 were prevented from being emitted into the atmosphere – which is equivalent to over 56,000 km worth of driving by a typical family car. That figure would almost double if the concrete-reducing effect of the foundations were added, even before considering the buildings other low carbon materials, and the amount of sequestered carbon in the building's wide palette of timber materials.

The family moved in last September, and so far, all is great. "The heat is so consistent," says Mary Dolan. "You don't have to worry about closing doors or drafts. You're not worrying about the kids being cold, even when you bathe them. I remember as a child shivering for an hour after a bath, but here it's always warm," she says.

But the real proof of the pudding is in the energy bills. "We checked the running costs of the heat pump from the 22nd of August 2016 to the 7th of Feb 2017. It's €190 in total for heat and hot water, with hot water taking €110 of that." The Dolans also spent €75 for one barrel of gas — that makes for a total of just €155 for space heating through most of autumn and winter.

Want to know more?

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(clockwise from top right) Ampak's Variano membrane, fitted to walls and roof, provides airtightness and vapour control for the timber frame structure; metal web joisting in the ceiling to contain services such as ventilation ducting; raft foundation insulated with 250mm Kore Insulation, and 215mm Quinn Lite blocks to perimeter and rising walls; the pitched roof has been fitted with a 4kW integrated PV array and also features a Velux quadruple-glazed solar powered roof window; the house is finished with carefully detailed sustainable timber cladding; the wood fibre external insulation extends over the frames of the timber windows, reducing the surface area of window frame exposed to the elements.

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WINDOWS & DOORS

SELECTED PROJECT DETAILS
Client: Niall & Mary Dolan
Architect: Miles Sampson
Contractor & project management: GreenTec Ecological Homes
Timber frame: Kudos (erected by Emmet Nee)
Energy consultant: MosArt
Mechanical contractor: Western Energy Systems
Electrical contractor: F&H Electrical
Airtightness tester: 2eva.ie
Heat pump & underfloor heating: Unipipe
MVHR: Brink HRV
Cellulose insulation: Sustainable Insulation Products
Wood fibre insulation & airtightness products: Partel
Thermal breaks (Foamglas blocks): TIDL
Thermal blocks: Quinn Building Products
Floor insulation: Kore
Windows: DBP Fenestration Ltd
Roof window: Velux
Entrance doors: Geraghty Joinery
Cladding: Machined Timber Specialists Ltd
Screeds: Esker Readymix
GGBS: Ecocem, via Esker Readymix
Solar PV: Solar Century
Gas stove: JP Distributors
Timber flooring: Bearfoot
Flat roof membrane: Newell Roofing Products
Acoustic flooring underlays: Sheep Wool Insulation

PROJECT OVERVIEW

Building type: 200 square metre detached two-storey timber frame house

Completion date: August 2016

Budget: €380,000

Passive house certification: pre-submission

Space heating demand (PHPP): 15.56 kWh/m^2

Heat load: 9.57 W/m^2/yr

Primary energy demand (PHPP): 73 kWh/m^2

BER: Pending

Energy bills: €110 for hot water and €80 for heating from 22 Aug 2016 to 7 Feb 2017 (heat pump); €75 for gas stove in same period.

Airtightness: 0.58 ACH at 50 Pa (final test yet to be completed)

Ground floor: Raft foundation insulated with 250mm Kore Insulation and 215mm Quinn Lite blocks to perimeter. *U-value:* 0.119 W/m^{2}K

Walls: Factory-built timber frame with 22mm larch cedar & render externally, followed inside by 50 x 50mm treated battens and counter-batten, Ampack UV façade membrane, 80mm wood fibre board, 235 x 38mm cellulose-filled timber stud, Ampack membrane taped and sealed, 50mm service cavity insulated with Rockwool insulation, and 12mm MGO board internally. *U-value:* 0.126 W/m^{2}K

Roof: Salvaged Blue Bangor slates externally on 50 x 35mm battens/counter battens, followed underneath by breathable Ampack roofing underlay, 100mm wood fibre, 235mm timber joists/rafters fully filled with cellulose insulation, Ampack airtight membrane, 50 mm uninsulated service cavity, 12mm MGO plasterboard ceiling

Windows: M-Sora Natura E112 passive certified triple-glazed timber windows. *Overall U-value:* 0.77 W/^{2}K

Roof window: Velux quadruple-glazed, passive house certified, solar powered roof windows. *Overall U-value:* 0.70 W/m^{2}K

Heating system: Nibe VVM 320 air source heat pump with underfloor heating everywhere apart from sitting room. 200 litre hot water tank. DRU Global 60 gas fire with balanced flue to sitting room.

Ventilation: Brink 400 MVHR unit, Passive House Institute certified heat recovery efficiency of 84%.

Electricity: 4kW solar PV to roof slates

Green materials: Timber frame, MGO dry lining board, salvaged slate, cellulose insulation, wood fibre insulation, salvaged stone, GGBS cement (50% in slab, 25% in screeds), sheep wool carpets, cedar cladding, all-timber windows, sedum roof still to be fitted.

Photos: Alan Parker

Historic London house GETS NEAR PASSIVE TRANSFORMATION

The default answer when you want to do pretty much anything to a listed building is ‘no’. The default assumption if you want to achieve the Enerphit standard for retrofit is ‘tackle everything’. So how on earth do you retrofit a listed building to within a whisker of the Enerphit standard — with the blessing of the conservation officer?

Words: Kate de Selincourt

Georgian Bloomsbury was developed in the early years of the 19th century. Fashionable then, the elegant and well-proportioned streets, with many long terraces still relatively intact, are still valued. The historic exteriors and interiors alike are fiercely protected by the planning system, and local authority conservation officers.

When Bob Prewett of Prewett Bizley Architects was approached for help with turning this five-storey Georgian house in Bloomsbury back from an office building into a family home, and an Enerphit-standard home at that, he knew it would not be straightforward. But he also believed that if they could achieve Enerphit, the passive house standard for retrofit, while retaining all the elegance and historic value of the building, then an important precedent would have been set.

While the clients were keen to reduce the energy consumption of the building for their own comfort — and out of responsibility to protect the planet — architect, client and their selected contractor Bowtie were all as concerned as the conservation officers to tread lightly with the historic fabric. And this sensitivity shines through the project.

The first stage in any retrofit is to return the fabric to good condition, to ensure it is performing optimally in its own right, and to give a safe, dry basis for insulation and other energy-saving measures. So it was here. The disintegrating cement pointing (the external part of the mortar joints) was removed, and replaced with lime based mortar, to reduce water penetration from driving rain, and allow any moisture reaching the brickwork to dry out safely. The parapets were leaning slightly inwards, not throwing water effectively away from the façades, so they were partly rebuilt and given new copings.

Inside however, most of the structure was in good condition. “There was a phenomenal amount of timber, it looked like shipbuilding,” Bob Prewett recalls. “There are effectively massive trees making the main beams with a six metre span from party wall to party wall, with cross joists notched into those, supporting the floors, with ceiling joists below. And all the internal partition walls, everything, was made of timber.” Happily only a few small areas were rotten and needing repair.

Insulation strategy

Different parts of the building had different construction, different building physics challenges, and differing historic value, so the insulation strategies also varied. At the top (the old servants quarters) and bottom (basement) of the building, there was not much of historic interest remaining, so the challenges to overcome were mainly technical. The beautiful historic interiors were on the ground, first and second floors. They had retained their original marble fireplaces, ornate cornicing, and original woodwork, including shutters and shutter boxes. Although the windows had been replaced in the Victorian era, they replicated the elegant sliding sashes of the Georgian originals.

The front and back façades at these levels had ‘false’ lath-and-plaster walls inside created by the original builders, to accommodate the depth of the shutter boxes without the need for an excessively thick brick wall (a lath is timber framework on which plaster is applied). This left a cavity behind the Georgian lath and plaster, which could be insulated without touching the interior decor.

One option considered was to blow cellulose into the cavity, but the blower might have put pressure on the old construction, and there were also concerns about exposing the

cellulose to moisture risk from the exterior brick, says Bowtie director Rafael Delimata. The team opted to use vapour-open Icynene pour-formula. Delimata says this approach – which had been analysed in a monitoring and simulation study in a lath and plaster sandstone wall – worked well. Bowtie find that the liquid formula fills even irregular cavities easily, and it greatly increased the airtightness of the walls.

So long as it is specified and installed with care, both Bob Prewett and Bowtie believe Icynene foam to be a useful product. Bowtie have their own rig so they have full control over the installation. "Our team are fully trained to use it. We also inspect the substrate carefully, and check the U-values and carry out condensation risk analysis." Delimata says. Stormdry repointing additives were mixed in to the lime mortar for repointing the elevations.

"We have not found a more environmentally friendly option for those jobs where really you cannot easily insulate any other way, and it is cost-effective," says Delimata. The party walls also had to be insulated. Even a few degrees temperature difference in the adjoining space (for example if neighbours were absent) would add considerable heat loss, given that the party wall area is so large (around double the area of the façades). In the middle storeys the party walls had the same decorative woodwork and cornicing as the elevations, but no cavity. And as well as being insulated, these walls had to be made airtight.

Remarkably this was achieved within the 30-40mm depth made available by removing the existing plaster. The old brickwork was made airtight with a lime parge, and the walls were then lined with 20mm of Aerogel [an extremely high-performance synthetic insulant] on a 10mm magnesium oxide board, giving a U-value of around 0.23, then finally skimmed. It was a lot of Aerogel – and it isn't cheap. As Delimata recalls, when the insulation arrived "it was the most expensive pallet ever!"

Basement, attic and roof

The basement was damp, "but we would never have got to the bottom of where it was coming from," Bob Prewett says. So the basement walls were lined with a cavity drain tanking system ("probably overkill," Prewett suspects). On top of this tanking membrane was a layer of Icynene, but given the proximity to damp, not the vapour open system, but instead the waterproof closed-cell formulation.

In the top storey (the former servants' quarters) few historic details remained. Internal insulation was with Pavadry wood fibre boards, which interlock in a tongue-and-groove system, with the joints taped for extra airtightness. "Pavadry is nice to use, it's very robust and would withstand a lot of abuse," Delimata notes. The ceiling was made airtight with OSB board, while 50mm of glassfibre in the attic was replaced with 300mm of cellulose, which has recently been checked and is very dry.

Airtightness/windows

The airtightness strategy was all internal: lime parge was used extensively, though in places this role was fulfilled by insulation (and taping) instead. To maintain airtightness

the lime parge was allowed to dry slowly, to prevent cracking, before other layers were added. "This appears to have held very well," Prewett says.

However there were also a lot of junctions to deal with, often complicated by additional structural penetration such as floor beams. Parging up to the beams and taping was done where possible, but to fill some of the really inaccessible gaps, open-cell Icynene foam was used, to tackle heat loss and reduce air leakage.

Internal insulation around penetrating timbers is thought to be safe so long as the timbers are dry to begin with, the insulation around them is vapour open (to allow timbers to dry into the warm interior if needs be) and the U-values are not too onerous. "The walls were in fact pretty thick, and the insulation was a modest layer, this meant we were allowing a bit of warmth back into the wall, to keep the timbers warm. We didn't go below about 0.3," Prewett explains.

He adds: "The beauty of a tall terraced house is the excellent form factor. The exterior walls are quite a small proportion of the surface, which means you don't need to get a very low U-value to achieve thermal performance of Enerphit or close to." In the basement, the tanking membrane proved hard to make airtight, but once the foam insulation had been installed, the airtightness was much improved, Prewett says.

The original fireplaces also had to be made airtight, which was quite tricky, Prewett recalls. "The chimneys were filled with vermiculite. We grouted and sealed the marble chimney pieces and the cast iron surrounds, and parged the backs, which was fairly successful, even though the old brickwork is like a honeycomb, there are so many gaps in the mortar."

"Achieving 1.1 air changes per hour, given the challenges, is quite remarkable and shows

how airtight even challenging projects can be made, given a team who are committed and conscious of the issues."

Historic windows

But the biggest issue faced by the team was obtaining listed building consent for the proposed alterations and in particular, for the secondary glazing system. It took over 18 months to get the go-ahead for this, which was a "huge headache" for the sequencing of the build. "It caused a lot of pain to the contractor." Prewett says.

Eventually, and after repeated, slightly different applications, the conservation officers gave them the go-ahead — though not before the sash windows and boxes had been taken apart once to repair the windows, then reinstalled for inspection.

The secondary glazing is an evacuated double skin pane only 6.2mm thick, on extremely slender frames. The U-value of the glazing is quoted as 1.0, the figure used in the calculations, though in-situ testing of this system for Historic Scotland has suggested a marginally better U-value in reality, of between 0.6 and 0.8.

The whole system is fitted between the sash window and shutter box, so it is really inconspicuous. On the larger windows the secondary glazing is in sliding sashes mirroring the main windows; the smaller windows have casements.

Unfortunately, because the permission took so long to be granted, the build had to proceed with the possible end point of single glazing only, meaning designs and preparations were made for a supplementary heating system. The heat pump and low-temperature underfloor heating specified for the Enerphit-level fabric would not have been adequate in this scenario.

"Suddenly the whole room became comfortable, instead of having one cold side. And the whole room became instantly quiet."

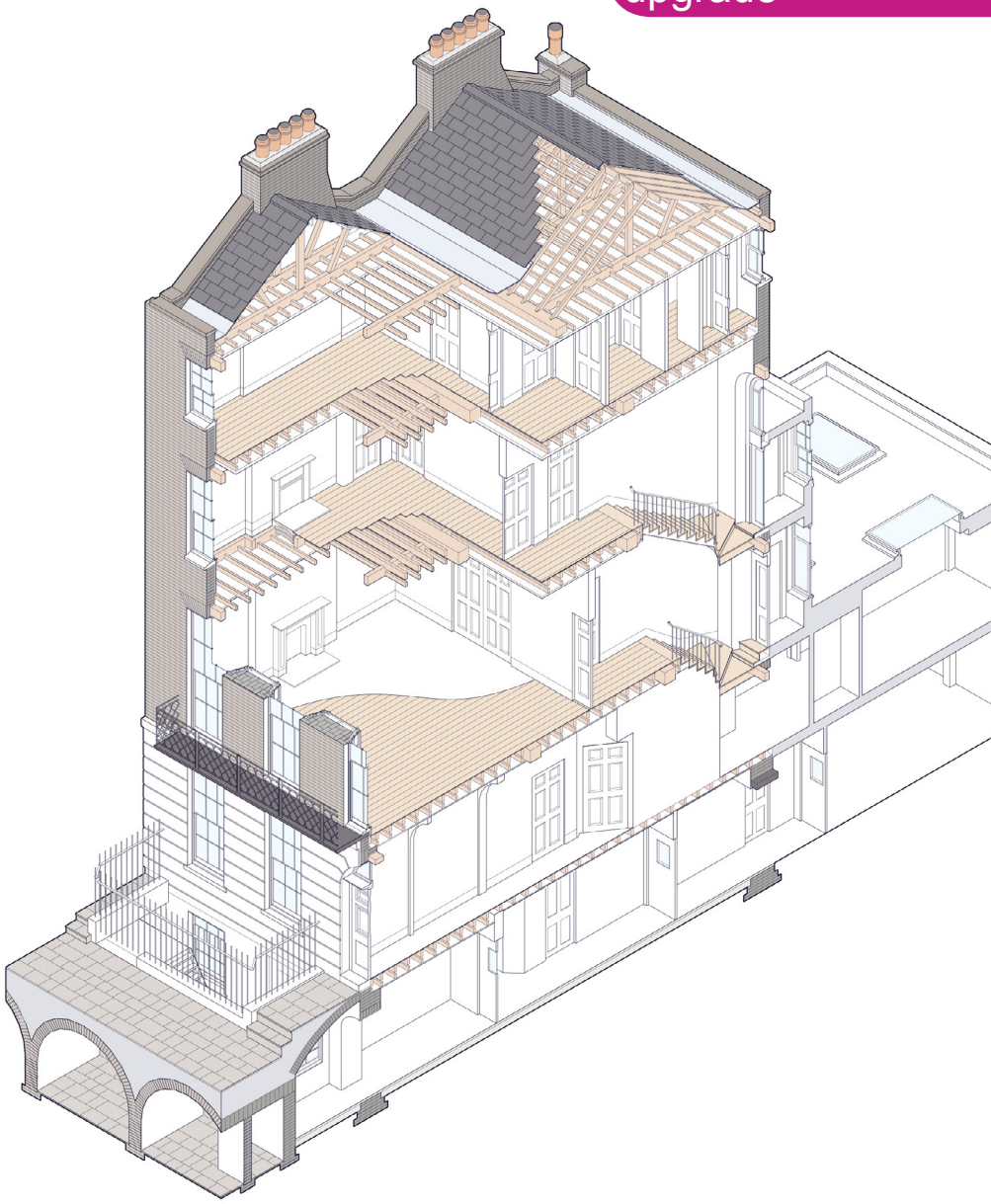
Delimata estimates these reversals and delays (including several extra visits from the airtightness tester) probably cost his firm around £5000, eating quite a chunk from their overall profit. “But we did feel we were doing something worth doing, showing that Georgian sash windows could be sensitively updated, to enable really high energy performance throughout.”

This was not just the icing on the cake. The new windows are crucial to the improved energy performance, making more of a difference to the heat loss than the wall insulation. “In these houses there is a very large glazed area, and single glazing has terrible performance, with a U-value of around five,” Prewett points out. “The windows are about 40% of the external surface area but accounted for half the heat loss — a huge amount.”

Two MVHR systems were installed by Bowtie, one in the attic serving the upstairs bedrooms, and the other in a service riser at the back of the dwelling, to minimise the need for duct penetrations through the historic structure. “Heating is by air source heat pump and we also installed solar thermal panels, as the client was very particular about not using gas,” Delimata says.

Most of the work, including the services installation, was carried out by the contractor’s in-house multi-skilled team, rather than an army of sub-contractors. Bob Prewett believes this played an important part of the success of the project: “Most of the crew are multi-skilled, which means they understand each others’ roles, and know what the other processes are going to need, and they can join in to help catch up if one element is behind, rather than wait around, meaning work can be streamlined. It’s a real team approach,” he says.

“Rafael was there most days for the best part of a year,” Prewett adds. “You just do need that level of supervision and coordination.”



(top) An axomometric cut through of the house and structure before the work began; (above, from left) the timber frame extension to the rear under construction; the disintegrating cement pointing was removed, and replaced with lime based mortar to reduce water penetration from driving rain; the top storey was internally insulated with Pavadry wood fibre boards, with plasterboard outside this, while OSB to the ceiling above is taped for airtightness; ductwork for the MVHR systems, and airtightness taping around joints and junctions.

Performance

Calculating the energy performance before and after the retrofit suggests that while the heat demand of the unimproved fabric would have been around 180 kWh/m^2/yr, retrofit will have slashed this by nearly 90% to 20 kWh/m^2/yr. Although this is within the limits set for Enerphit, the airtightness is slightly over the Enerphit target of one air change per hour, so the building doesn't qualify for certification. Nonetheless, the level of energy efficiency and comfort achieved, alongside the preservation and restoration of a listed historic fabric, is outstanding.

The occupants were able to get a vivid demonstration of the impact of one aspect of the retrofit. "Because we had to wait so long for permission to add secondary glazing, the clients moved in before it was installed. It was late autumn when it finally went in, and suddenly the whole room became comfortable, instead of having one cold side. And the whole room became instantly quiet," Prewett recalls. "The window treatment was expensive but had a huge impact. The effect of the windows on the energy consumption, comfort and acoustics of the house is palpable when you are there."

"So far we have just set up sensors to monitor internal air quality and electrical use. Initial review indicates good stable temperature and humidity levels, as well as low CO_2 levels. The energy consumption for the first year is a bit over prediction — this may have had something to do with there still being builders on site here, plus an empty property next door for some of that time."

At around £1.2million the job was certainly an expensive one, but the energy works did not account for the lion's share, by any means. "A lot of the work would have had to be done anyway to achieve such a great restoration of the interiors. There were also a number of new items and fittings that cost a lot. In the end the energy efficiency work was probably only a third of the budget," Prewett says.

Is it time to update our approach to historic buildings?

Overall the whole team is very proud of the quality of the conservation. But as Bob Prewett says, the problem with listed buildings is that "the default answer to touching anything is 'no'". Energy upgrades of listed buildings can be done badly of course, but to outlaw everything as default is immensely unhelpful, he believes.

"Listed buildings can contribute to carbon reduction without being spoiled. Given that many listed buildings are in the possession of people with the means to carry out this type of retrofit, it is a pity that they are usually blocked from doing so by very conservative planning views and a culture of do nothing."

Yet with this retrofit, while achieving one of the best-ever fabric performance levels for a listed building, the conservation officer was so delighted with the outcome they wanted to take photos, as Delimata recalls, "to show other people how it should be done". Perhaps these photos should be shared far and wide amongst the conservation officer community, to make them just a little less frightened of allowing the owners of listed buildings to protect the future. As this retrofit shows, it doesn't have to mean you lose the past.

Want to know more?

The digital version of this magazine includes access to exclusive galleries of architectural drawings.

The digital magazine is available to subscribers on www.passive.ie

SELECTED PROJECT DETAILS
Architect: Prewett Bizley Architects
Interior designer: Emily Bizley Interior Design
Passive house design: Prewett Bizley
Contractor: Bow Tie Construction Ltd
Quantity surveyor: Mark Hammond
Structural engineer: Studio Park
Wood fibre insulation: Natural Building Technologies
Lime plaster: Lime Green
Blown cellulose insulation: Warmcel
Aerogel MgO board: Thermablok
Sprayed insulation (open and closed cell): London Insulation
Airtightness products: Ecological Building Systems
Ground floor & flat roof insulation: Kingspan
Windows & doors: Selectaglaze, Double Good
Parquet flooring: Luxury Wood Flooring
Solar thermal & air source heat pump: Chelmer Heating
Wall paints: Keim
MVHR: Paul, supplied by Green Building Store
LED downlighters: Photonstar
External blinds: Reflex-Rol UK
Aluminium rainwater goods, external railings and other sundry metalwork: Brian Cherry

PROJECT OVERVIEW

Building type: Four-storey over basement, 1820s terraced townhouse with 20th/21st century extension at the rear.

Location: Bloomsbury, London

Budget: £1.2m

SPACE HEATING DEMAND (PHPP)
Before: 180 kWh/m²/yr

After: 20 kWh/m²/yr

HEAT LOAD (PHPP)
Before: 163 W/m²

After: 17 W/m²

PRIMARY ENERGY DEMAND (PHPP)
Before: Not modelled

After: 114 kWh/m²/yr

AIRTIGHTNESS (AT 50 PASCALS)
Before: >10 air changes per hour

After: 1.1 air changes per hour

BASEMENT FLOOR
Before: Carpet over cement screed over a concrete slab. *U-value:* 2 W/m²K

After: Tiles on 75mm screed with integrated UFH, on 75mm XPS, on tanking, on 50mm XPS, on existing concrete slab. *U-value:* 0.23 W/m²K

ORIGINAL WALLS
Before: London stock brick, with plastered walls (some plastered linings were mounted on stud work fixed to brick internally.) *Approximate U-value:* varied from 1.2 to 1.8 W/m²K, depending on wall thickness.

After: Lower ground floor wall: taped OSB on studs on lime page, with vapour closed spray-foam insulation between. *U-value:* 0.27 W/m²K

Mid floors: Existing lath and plaster lining on studs with vapour open poured insulation between. *U-value:* 0.22 W/m²K

Top floor: Plasterboard on battens over taped wood-fibre insulation boards, fixed to lime-parged faced. *U-value:* 0.3 W/m²K

Party walls: Lime plaster on MgO board faced Aerogel, fixed to lime parged walls. *U-value:* 0.23 W/m²K

EXTENSION WALLS
Before: Brick with poor tanking system and dry lined. Approximate *U-value:* 2 W/m²K

After: Taped OSB on studs with vapour open sprayed insulation between. *U-value:* 0.27 W/m²K

Lime rendered wood-fibre insulation boards applied to a timber frame with mineral wool insulation between. *U-value:* 0.1 W/m²K

MAIN HOUSE ROOF
Before: Slate tiles on roofing felt over double pitched timber rafters. 50mm of glass wool between ceiling joists (below vented double pitched roof). *U-value:* 1.2 W/m²K

After: Slate tiles and roofing felt repairs. 300mm cellulose between and above ceiling joists. OSB installed to underside of existing ceiling joists. All joints and junctions taped with Pro Clima tapes. *U-value:* 0.12 W/m²K

SPACE HEATING SYSTEM
Before: 30 kW gas boiler.

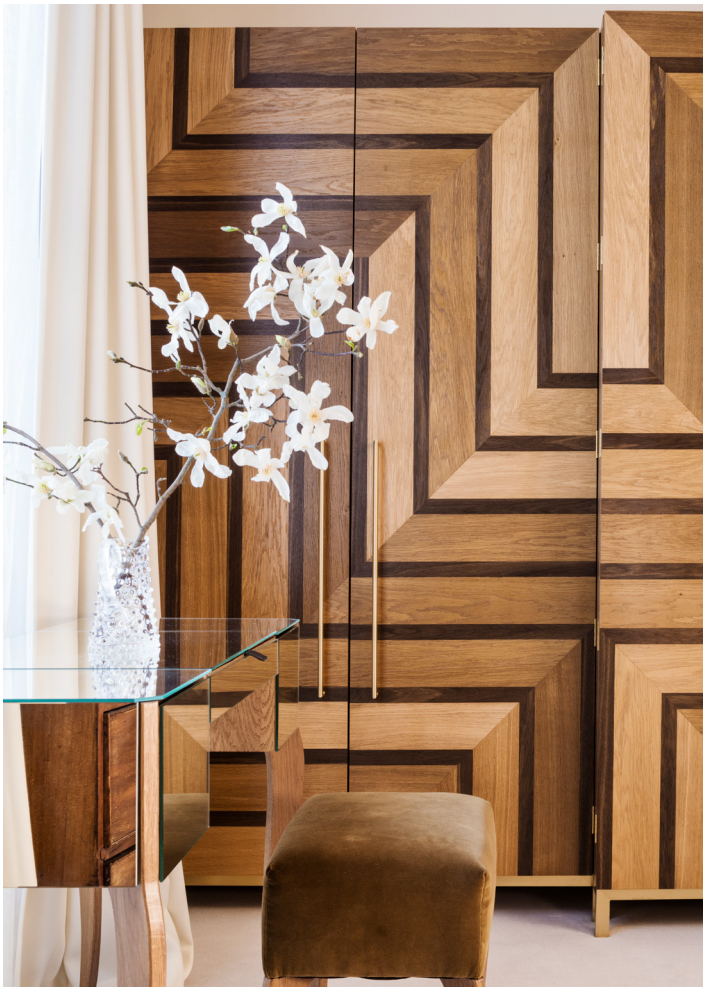
After: Wet under floor heating to all spaces excluding third floor, which uses low temperature radiators. Supplied by buffer tank connected to one air source heat pump.

HOT WATER
Before: Commercial - local electrically heated hot water in WCs.

After: Solar panels connected to a 500 litre hot water tank and air source heat pump.

VENTILATION
Before: No active ventilation system. Reliant on infiltration, chimney and opening of windows for air changes.

After: Two Paul Novus 300 MVHR systems. Effective heat recovery efficiency of 93%



“Right now, it’s perfect.
We don’t have to heat
the house at all.”

Photos: Imageworks

Step-by-step Wicklow upgrade

TAKES THE LONG VIEW

This stylish contemporary upgrade and extension could provide a template for the deep retrofit of many family homes, with its owners aiming to bring it up to Enerphit, the passive house standard for retrofit, gradually rather than all at once.

Words: John Hearne

In any building project, you've got to be pragmatic – and in retrofits even more so. Just because you're going passive doesn't mean you throw out everything that isn't perfect.

This is a point Art McCormack of pioneering passive house architects MosArt is keen to emphasise. "If you were talking to anyone at the Passive House Institute, these guys would be the first to say you don't just go mad with retrofitting. You need to adopt a pragmatic and cost-optimal mindset," he says.

This is why, when MosArt began work on Simon Maher and Siobhan Kennedy's deep-retrofit in Glenealy, Co. Wicklow, both client and design team focused on getting the very best out of the available budget.

Simon Maher explains that when they moved into the house, which was built in 1989, they found it very difficult to heat. "Gas was costing us an astonishing amount of money," he says. "There was only single glazing at the time, so the first thing we did after we bought the house was to put in double glazing, and we also installed external insulation."

He and his wife Siobhan never intended to stop there, however. They knew that down the line, they'd need to extend the house for their growing family, and that when they did, there would be an opportunity to improve the energy profile and comfort of their home further.

"Myself and my wife are quite passionate about the whole area of sustainability," says Maher. "We obviously wanted to reduce our financial outgoings, but we were also aware of our impact on the environment. We wanted to reduce our footprint as much as possible, while also giving us more space for our family to live in."

Because the existing double-glazed windows were relatively new, and the old part of the house had already been externally insulated, the decision was taken to leave that section of the building largely untouched, and to concentrate on a new extension.

The house, situated in what Art McCormack describes as a loose suburban setting about a mile from Glenealy village in Co Wicklow, had the advantage of a great orientation, with the living areas enjoying south and south-westerly sun. As part of the brief, the clients asked for a greater connection between house and garden. McCormack – also a landscape architect – had worked on Pat Cox's passive retrofit in South Dublin (previously featured in this magazine). That project also called for greater unity between house and garden.

"We rethought the central living spaces — the living room, dining room, and kitchen," McCormack explains, "and that had a knock-on effect on how the bedrooms would

work. We concentrated those central family areas in the main, southwest facing extension and pushed it out into the garden, in the direction of the sun."

A hallway introduced at the centre of the house was designed to serve as a link between new and old sections. The design itself made extensive use of fold architecture, a familiar feature in contemporary buildings where a continuous material is used to create both wall and roof.

"The entrance canopy has a pressed metal roof that begins horizontally then drops down vertically," McCormack explains. "It's like a baseball glove, a way of catching the person as they approach the house. It also creates a subtle separation between the entry point and the more private living spaces at the back of the house. You're also creating a very clear distinction between old and new."

From a thermal point of view however, this feature had the potential to introduce a substantial thermal bridge. In a passive new build, thermal bridges can be detailed away by creating a continuous insulation layer. With deep retrofits, that isn't as easy to achieve.

Art McCormack explains that the inverted L-shape is primarily of timber construction and is tied back to the roof and filled with insulation, thereby preventing thermal bridging issues. Meanwhile, the lower end of the canopy is tied to a plinth of autoclaved aerated concrete blocks coated with bitumen. Aerated blocks are also used to mitigate thermal bridges at the junction between the new flat roof and the existing masonry gable.

Creating a continuous, flush external finish so that the link between old and new is seamless was also a challenge. The blockwork walls of the existing house, with an insulated 50mm cavity, had been finished with 170mm EPS insulation and a mineral render. The cavity walls of the new extension feature a fully insulated 150mm cavity, plus some internal insulation. The design and build teams used blockwork and external insulation to fill in any differences in wall thicknesses, and along the west wall, a new floor-ceiling window forms the transition between the old and new.

As has become standard in block built passive projects, the key airtightness measure was the internal wet plaster finish, in combination with airtightness membranes and tapes at windows and around junctions.

For contractor Peter Roche, this was the first passive standard retrofit that he'd been involved in. The learning curve, he says, was steep.

"There was a lot of work in it, and a lot of time. All the taping you have to do is very time consuming. It can't be done in a hurry." Unusually, the building was subjected to blower door tests – by experienced airtightness consultant Gavin O Sé of Greenbuild – before and after the works were done. The initial test recorded a fairly respectable airtightness result of 5.155 air changes per hour (n50). When everything was concluded, the result came in at 1.17 ACH. This falls just a little short of the Enerphit standard of one air change per hour, but is still a very substantial improvement, and vastly superior to conventional projects – retrofits and new build alike.

"The biggest job was the downlighters," says Roche, "keeping those airtight. Even though we talked to all of the tradespeople on site about how important it was not to puncture the membrane – and to tell us if they did – someone did put a hole in it, and never told us. We were able to remedy it, but it did cause problems at the time."

Roche has subsequently completed two low energy builds and achieved sub 1.0 air change results in both cases.

Though a well-designed mechanical ventilation system may have been advisable pre retrofit, given the home's relatively tight fabric, the much improved airtightness profile made it essential. The team chose a Paul Novus 300 MVHR system with a heat recovery rate of 84%, though the ducting was damaged during installation.

McCormack explains that MVHR ducting must be airtight, insulated and vapour tight. Damage to any element of those protective layers will make it impossible for the system to do its job properly, and can lead to condensation and all its attendant problems.

The client opted to continue with gas central heating, replacing the twenty-year old boiler with a new, condensing unit, supported by a room-sealed solid fuel stove. Just over a year in the house, Simon Maher reports that heating bills have dropped dramatically. Prior to the works, the household was spending between €1,800 and €2,000 annually on gas. Since moving back in, the bill has stayed below €850.

"Right now, it's perfect," he says in early February. "We don't have to heat the house

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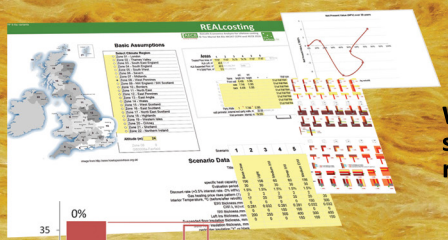

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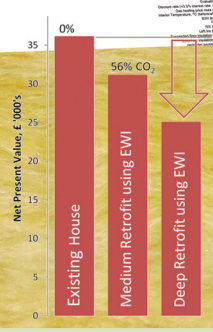

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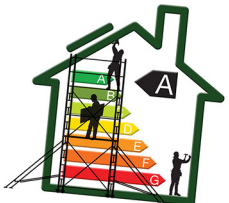

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at all. We're getting around 22 degrees throughout the day and we supplement that with our wood burning stove in the evening if it gets cooler."

One issue that did arise during the summer was overheating. It had however been foreseen. Because of the extensive glazing to the south west, south and south east, a brise soleil had been specified in the original design. "A louvered brise soleil is like a pergola which is half building, half garden," says McCormack. "The mindset came from the original design specification; we were trying to solve an energy related problem – overheating – with an architectural landscape solution."

Simon Maher explains that he plans to complete the installation of the brise soleil this year, when he and his wife Siobhan begin to tackle the garden.

The couple also installed a rainwater harvesting system as part of the project. This was originally designed to provide water for the garden, for washing and for toilet flushing. In use however, it emerged that the water just wasn't sufficiently filtered to work in showers and wash-hand basins. Moreover, Maher was surprised to find just how quickly the family got through the 6,000 litre tank – even after the system was diverted for use in toilets and the garden alone.

Another measure Maher and Kennedy took prior to the latest retrofit was the installation of a solar PV array on the roof. The installation was completed in time to take advantage of ESB Networks' now discontinued support package for microgeneration. That, says Maher, had been very helpful in making installations like this feasible.

"Our energy consumption fell by around 42% after we installed it," he says. "It's interesting to note that because there are more mechanical units in the house now – the HRV, and the pumps in the septic tank and the rain water harvesting system – our electricity consumption has increased slightly, but that's more than offset by the big reduction in gas consumption."

This magazine recently featured Art McCormack's deep retrofit of his own home in Co. Wicklow. That project is part of the Passive House Institute's Europhit programme, which promotes and supports step-by-step Enerphit projects. As the name suggests, these are building works which take the long view. You ultimately want a high performing, low cost, high comfort house, but you lack the resources to do the job all in the one go. So, like Art, like Maher and Kennedy, you adopt a long term plan and stagger the works – allowing the savings from low energy living to help finance further work down the line.

"The Maher Kennedy's house can be pushed fully towards the Enerphit standard over time," says McCormack, "by perhaps changing the windows in the future, or maybe taking further airtightness measures."

"Step-by-step retrofitting is a great way of making these works possible."

Want to know more?

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SELECTED PROJECT DETAILS
Clients: Simon Maher & Siobhan Kennedy
Architect: MosArt Architects
Civil & structural engineer: Deane Turner & Associates
Energy consultant: MosArt Architects
Main contractor: Peter Roche Construction
Mechanical contractor: Syl Doyle Plumbing & Heating
Electrical contractor: Robert Hassey Electrical Services Ltd
Airtightness tester: GreenBuild
Windows & doors: Munster Joinery
Cladding: New Century Roofing
Ventilation: Ollie McPhillips Ltd
Airtightness products: Isover

(top) Sliding doors with frosted glass offer flexibility: privacy or seamless open plan (above, from left) The floor to the new extension has 200mm Xtratherm PIR insulation & 60mm perimeter upstand; the cavity walls of the new extension feature a fully insulated 150mm cavity with Xtraththerm CavityTherm board; the inverted L-shaped entrance canopy is of timber construction, and is tied back to the roof and filled with insulation to prevent thermal bridging; the key airtightness measure was the internal wet plaster finish, in combination with airtightness membranes and tapes at windows and around junctions.

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PROJECT OVERVIEW

Building type: Existing single-storey dwelling, built in 1989 using cavity wall construction. Existing floor area 110 sqm. New extension of 39 square metres to side of existing dwelling.

Location: Ballincoola, Glenealy, Co. Wicklow.

Completion date: December 2015

Budget: €190,000

Enerphit certification: pre-submission (certifiable by component method only)

BER: Not calculated

SPACE HEATING DEMAND

Before: Not available

After: 39 kWh/m^2/yr

HEAT LOAD

Before: Not available

After: 15 W/m^2

PRIMARY ENERGY DEMAND (PHPP)

Before: Not available

After: 131 kWh/m^2/yr

ENERGY BILLS

Before: €1,800 to €2,000 per annum on home heating LPG Gas

After: €850 on LPG Gas cylinders

AIRTIGHTNESS (AT 50 PASCALS)

Before: 5.155 air changes per hour / 3.852 m^3/hr/m^2 (q50)

After: 1.17 air changes per hour

FLOOR

Existing floor consists of a concrete floor slab with 50mm polystyrene insulation. *U-value:* 0.546 W/m^{2}K

Floor of new extension consists of 150mm power-floated concrete floor slab with 200mm Xtratherm PIR insulation & 60mm perimeter upstand, on radon barrier, on sand blinding, on stone hardcore base. *U-value:* 0.105 Wm^{2}K

EXISTING WALLS

Before: 20mm render finish on 100mm concrete block outer leaf, 50mm cavity, 50mm polystyrene insulation board to cavity, 100mm concrete block inner leaf, sand/cement wet plaster finish. *U-value:* 0.7 W/m^{2}K.

After: 170mm EPS insulation and mineral render finish externally, 50mm blown bead insulation into existing cavity. *U-value:* 0.14 W/m^{2}K

Extension wall: 20mm render finish on 100mm concrete block outer leaf, on 5mm cavity, on 150mm Cavity Therm PIR insulation by Xtratherm, on 100mm concrete block inner leaf, on 10mm parge coat to form airtight layer, 60mm timber battens to form service cavity with 60mm PIR insulation between battens and plasterboard and skim finish internally. *U-value:* 0.103 W/m^{2}K.

ROOF

Before: Timber trussed roof with 150mm mineral wool insulation on the flat ceiling between roof joists and plasterboard ceiling internally. *U-value:* 0.30 W/m^{2}K

After: Addition of mineral wool insulation on top of existing insulation to an overall depth of 450mm, airtightness membrane to underside of ceiling, 25mm service cavity and plasterboard ceiling internally. *U-value:* 0.10 W/m^{2}K

Extension roof: Single ply roof membrane on 100mm Kingspan Kooltherm PIR insulation, on underlay, on 18mm OSB deck on timber firring pieces, on 225x44 timber joists at 400 centres with Metac mineral wool insulation between joists, airtightness membrane fixed to underside of joists, 25mm timber battens to form service cavity, plasterboard & skim finish internally. *U-value:* 0.095 W/m^{2}K

WINDOWS & DOORS

Before: Double-glazed, timber windows and doors. *Overall approximate U-value:* 1.80 W/m^{2}K. Note four existing windows were retained as they were relatively new and still in good condition but these will be replaced with triple-glazed units in the future, that will help to reduce the space heating demand and also improve the air tightness of the building.

After: Munster Joinery triple-glazed timber Aluclad Passive windows and doors: *Overall U-value* of 0.80 W/m^{2}K

HEATING SYSTEM

Before: 20 year old gas boiler & radiators throughout entire building.

After: New condensing gas boiler with existing radiators throughout, Room sealed solid fuel stove to living/dining area.

VENTILATION

Before: No ventilation system. Reliant on infiltration, chimney and opening of windows for air changes.

After: Paul Novus 300 Mechanical heat recovery ventilation system — Passive House Institute certified to have heat recovery rate of 84% / EN 308 certified efficiency.

Electricity: 3 kWp on-roof grid tier solar PV system. Monthly average electricity consumption was previously 561 kWh (annual consumption 6,730 kWh) and was reduced to 344 kWh (annual 4,124 kWh) post the installation.

Retrofitting value:

How much are energy upgrades worth?

Photo: Kelvin Gillmor

The sorts of simple payback analyses that are typically used to work out energy efficiency investments are dramatically underselling the financial benefits of retrofits. Tim Martel explains why a new calculation tool may be about to change all of that.

We know retrofit can bring comfort and style to a property but new calculations are now revealing that retrofits often also offer surprisingly good value financially when comfort is included. In the semi-detached house example here you wouldn't lose out if you moved 15 years or more after retrofit. In this article we look at how much you would be spending over the next 30 years on a typical English semi-detached house and Irish bungalow compared to the same houses with three different retrofit options: Building Regs, a medium retrofit and a deep retrofit. Costs include the initial capital cost, energy savings and other benefits. All the retrofit options were better value, some quite considerably so, and it turns out other benefits are a key part of that. It's important to note that the economic arguments here are based on engaging in a retrofit versus leaving the building unchanged, barring maintenance. In cases where major renovation works are already being planned, then the economics may change dramatically. If windows are being replaced already, it's a question of high performance windows over the minimum required. If an external wall is being rendered, much of the cost of an external insulation system is already required. In such cases, the marginal cost increase for a deep retrofit may be much lower than if no work was planned.

You may be familiar with the comfort aspect – a well realised deep retrofit can transform the experience of living in a home – constant thermal comfort, less risk of certain illnesses, reduction in ambient noise, sharper attention spans arising from better indoor air quality, and greater amenity from the house through making it possible to comfortably use the whole house, rather than just a heated section. While the cost of the work is a consideration it's not just about this, it's also about the extra advantages, sometimes called co-benefits. These are worth something, so realistic economic calculations need to include them. The following box explains some of the benefits.

"Whether the owner moves or not, the retrofits are still better than free for the owner when including co-benefits."

Benefits of deep retrofit to passive house level

1) It's warmer

The AECB looked at the typical house temperature of an un-retrofitted house for their Carbonlite Retrofit course and found DECC figures giving an average of 17C over the heating season. The house won't be heated all the time, nevertheless a retrofitted house is usually warmer in three ways – the air temperature is warmer, there are less drafts and the radiant temperature is warmer.

In a typical un-retrofitted house cold air descends next to a window or wall and chills our ankles and feet because the window has a cold surface temperature. We tend to notice this because the body is sensitive to a temperature difference of more than 2C between our ankles and body, and a difference of more than about 1C between the higher and lower parts of the room. Secondly we are also highly sensitive to drafts. Fanger monitored whether people felt warm, cold or just right when exposed to air temperatures combined with moving air (see the AECB Passivhaus Designer course). When air moves faster than 0.3 mph (0.15m/s) people need the air to be 1-2C warmer to compensate. The third effect is called radiant heat. Only about half our sensation of warmth is from the air temperature, the other half is from the radiant temperature of the objects around us. This means that a poorly insulated house with cold walls and windows has to have an air temperature warmer than 20C to feel the same.

You could compensate for these colder effects by heating your house to 21C. For a typical cavity wall semi with 200mm of loft insulation but no other insulation, REALcosting software suggests your yearly bill just for heating would be around £1300 a year using mains gas, not including hot water and cooking.

In passive houses, if the air is 20C, surfaces are all above 17C which eliminates the cold downdraughts and radiant heat effects near windows. Passive houses are also around 15 times less draughty than typical homes (in a pressure test, with all vents and windows closed and the building pressurised and depressurised, a passive house must leak no more than 0.6 air changes per hour, compared to circa 10 air changes per hour in a typical case). The extra warmth reduces the risk of some illnesses.

2) Modern appearance, elimination of mould

The appearance of new windows, a renewed external façade and new thermally insulated front door will be visible and will make the house more pleasant to live in. In most homes there are areas where some condensation or mould accumulates because of thermal bridges. Careful design in passive house retrofits can virtually eliminate the mould risk. The extra ventilation also helps avoid moisture build up. A special drying cupboard linked to the heat recovery system can be used for clothes drying and the air movement is much more effective at drying clothes without the moisture affecting the rest of the house.

3) Air quality, security, less street noise

Windows can be opened for ventilation in our existing home, but in winter we rarely do for very long which is why indoor air quality tends to be quite poor and can be high in moisture, volatile organic compounds (VOCs), particulate matter, mould spores and dust mites. The amount of ventilation is highly variable according to the wind conditions outside. In contrast mechanical ventilation with heat recovery (MVHR) runs at a very low level silently in a passive house and fresher air allows our attention to be clearer. For those next to a busy street an MVHR also reduces street noise, can provide fresher, warmer air from the top or other side of the building and is particularly suitable for ground floor flats where opening windows might be a security issue.

4) Increase in house value

House value is correlated to energy performance scores according to 2013 DECC study of 300,000 properties on the impact of Energy Performance Certificates on house prices, which noted a 14% house price increase for A-rated homes compared to G-rated homes. The effect was less marked in the areas around London, which the report suggests may be due to constrained supply, fewer heating degree days due to a more temperate climate and higher house prices relative to energy costs. Some are less concerned about this because they are not planning to move, so this effect has not been included in some of the following graphs and yet some day their children are likely to benefit. At the moment there's insufficient data currently to quantify how higher energy performance standards such as the passive house standard affect value – with the attendant expectation of quality, comfort, energy savings, more certainty about those savings, health benefits and perhaps even the notion of buildings as status symbols. Similarly, certain measures typical of deep retrofit such as a fresh new building façade – new EWI system, windows and doors - may positively affect the appearance of a house, which may also add value. To our knowledge, there has been a dearth of research in this area.

5) Protection from energy price rises

UK energy prices are expected to rise a further 5% in 2017 and it would be surprising if they didn't continue to rise in the future. Retrofitting to passive house levels gives some protection from that, as long as interest rates remain fairly low if the costs are funded through a mortgage.

(p90) Deep retrofit can add value by improving the façade of a building, such as this Simon McGuinness-designed certified passive upgrade in Co. Galway, which cost €55 to heat last year.

The economics of retrofit are transformed by including sensible figures for the value of the increase in comfort. The average temperature before retrofit is 17C according to DECC figures and after retrofit people will generally want it warmer, say 20C. The value of this extra 3C is relatively easy to pin down because for every retrofit there is an owner and we can ask them how much the new level of comfort is worth to them. Saint Gobain Ireland's building physics manager Fintan Smyth showed people pictures of parts of a retrofitted vs a non-retrofitted house and asked people how much extra they would pay for the retrofitted house, both as tenants and as house owner. The most common answer he got was about €150/month, the following example rounds that down a little in the conversion to pounds, £100/month.

The example in graph 1 is from a fictional semi-detached house in Manchester using the REALcosting software (Retrofit Economics Analysis and Lifetime costing), launched recently by the AECB. We look at the total cost of ownership over 30 years including heating, co-benefits and typical maintenance costs for a 1950s building. They amount to £14,000 of repair work over the next 30 years which is not unreasonable, and figures of course depend on the specific house in question so results will vary. REALcosting includes thermal bridges from its built-in library, costs of around 90 measures and suggests values for the increase in house price. The increase in energy price uses the DECC central forecast which is modest so as not to rely on it.

There are minimum requirements for retrofits set out by the building regulations. For instance, in both the UK and Ireland, if someone decides to do up a poorly insulated building and the area of the work covers more than 25% of the surface area of the building, or more than 50% of the area of any particular building element, such as walls, roof, floor, windows, doors then all of that element will have to meet Part L. So in our figures below we've included the cost of the minimum (English) Building Regs solution too, for comparison.

Costs of the retrofit, future energy bills and 'comfort value' are in 'today's money' (Net Present Value). This just allows for the fact that money in the future would be worth slightly less than money now according to a discount factor. Here it is the Government Green Book rate of 3.5% -2% inflation = 1.5%. It is used worldwide to compare the value of all kinds of projects from reservoirs to investments.

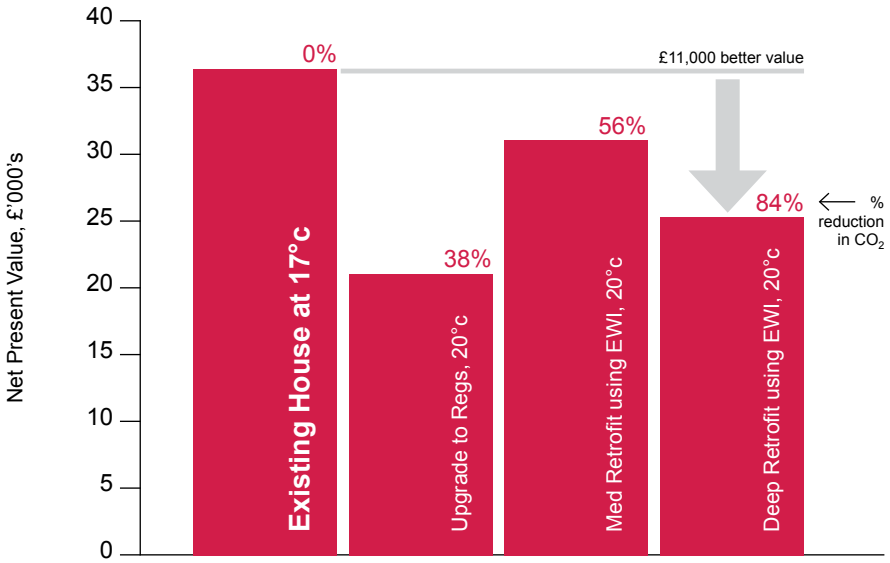
Graphs 1 and 2 respectively focus on a Manchester semi-d and an Irish bungalow, looking at what happens assuming the owner lives in the house over the next 30 years, including the £100/month comfort value. House value is excluded in these graphs because the occupants aren't intending to move, although one day the descendants of the owners will benefit from that. In the Manchester semi-d, the total value is £36,000 for the existing house, £21,000 for the Building Regs house, £31,000 for the medium retrofit and £25,000 for the deep retrofit. All the options are cheaper than the existing house and in addition the deep retrofit saves 84% of CO_2. Notably, in the Irish bungalow example – with its relatively more expensive fuel type of LPG and worse form factor – the monetary value of the retrofits is even greater, and the deep retrofit is the most economical option.

But what if the owners move after 15 years? Many people think that it wouldn't be worth retrofitting the house in case they might move, or perhaps they want to leave open the possibility that they might want to move when they retire. Graph 3 shows this situation. There's no loss from moving after 15 years, though longer would be better. The increase in house value is included here and has compensated so there is still no loss, though this does vary according to location. Therefore whether the owner moves or not, the retrofits are still better than free for the owner when including co-benefits.

(above) Example of what the semi- detached house might look like before retrofit.

1. Semi-detached house in Manchester

Value in today's money (NPV) over 30 years excluding increase in house value



(above) A semi-detached house in Manchester over 30 years. Comfort is included at £100/month, increase in house value from the retrofit is excluded assuming the owners don't move. Building Regs requirements use UK Part L element minimum U values only.

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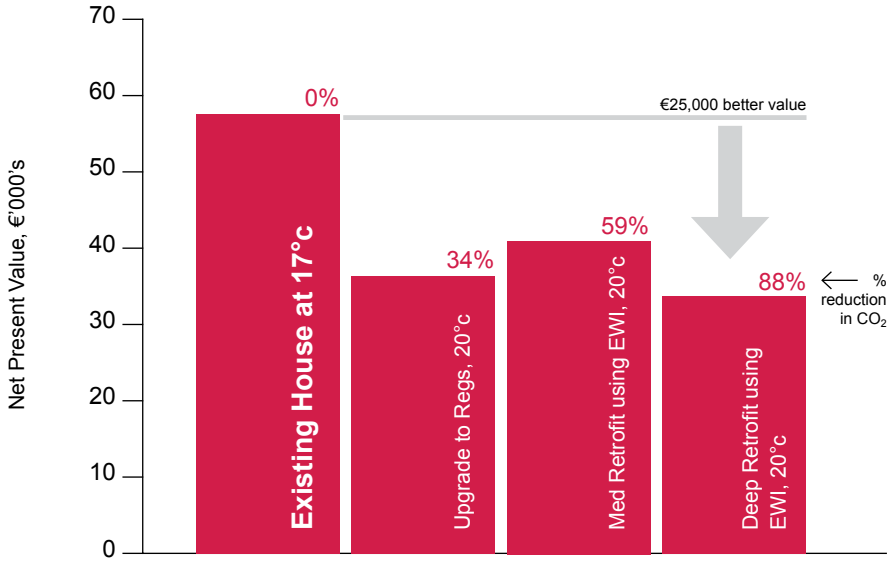
2. Detached bungalow in Ireland

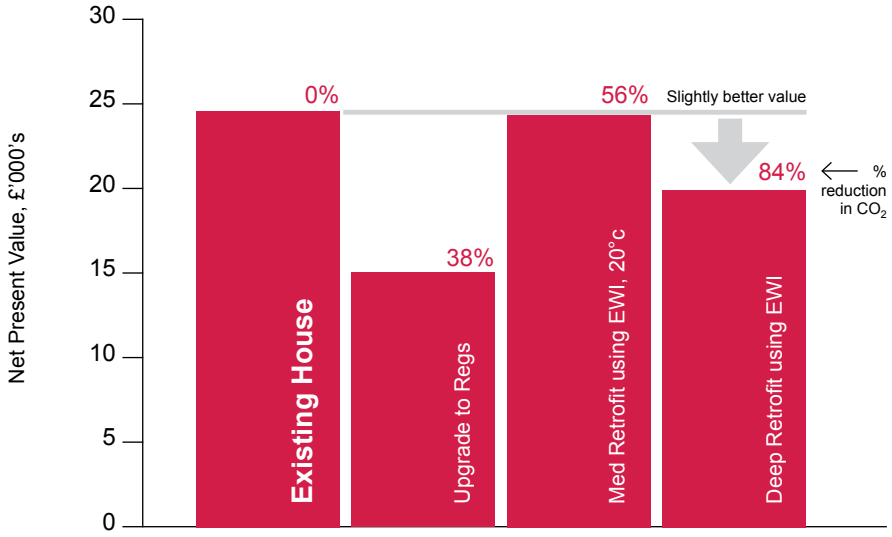
Value in today's money (NPV) over 30 years excluding increase in house value



(above) A detached bungalow in Ireland over 30 years. Comfort is included at £100/month, increase in house value is excluded assuming the owners don't move. Climate for Dublin, typical energy prices from SEAI, €0.0907/kWh for heating using LPG and €0.2306/kWh for electric. Converted to Euro using current rate where EUR €1 = STG £0.8533. Building Regs requirements use Ireland Part L element minimum U-values only.

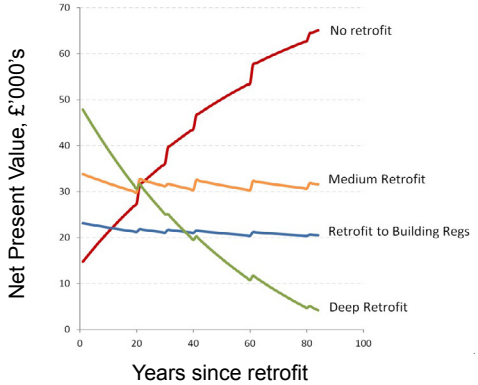
3. Semi-detached house in Manchester

Value in today's money (NPV) if owner moves after 15 years, including increase in house value



(above) A semi-detached house in Manchester over 15 years. Comfort is included at £100/month and increase in house value from the retrofit. Building Regs requirements use UK Part L element minimum U-values only.

4. Total cost of ownership including cobenefits



(above) A semi-detached house in Manchester over 30 years as in graph 1 but over time. Comfort is included at £100/month, increase in house value from the retrofit is excluded assuming the owners don't move. Building Regs requirements use England's Part L elemental minimum U-values only.

The software used in this article, REALcosting, includes much more than a typical economic calculation. It was initially developed over three years to produce figures for three standard house types in the AECB Carbonlite Retrofit course, but many delegates wanted to apply it to their own buildings. This took a fair bit of extra development, not least as a way had to be found to distribute the tool independently of PHPP and yet still allow it to use PHPP. The compromise, which the Passivhaus Institute is happy with, is that REALcosting works independently from PHPP but fills out the PHPP for you, writing only the cells that would have been filled in by hand. The Carbonlite Retrofit course also emphasised the need to include co-benefits and in this article co-benefits are included for home owners, but there are others that would apply to housing associations and landlords, such as reduced void time, reduced rent arrears, reduced maintenance and reduced complaints.

REALcosting Calculation

- Labour and material costs including consequential costs
- Energy calculation before and after retrofit in PHPP including thermal bridges
- Maintenance costs from current and future issues with the building
- Maintenance costs from routine work on newly installed goods
- Inflation, interest rates, energy prices and energy price rises
- Co-benefits such as the increase in comfort and the increase in house value

Buildings in the UK typically last 100 years or more and over the life of the retrofit or building, retrofit value is striking, as graph 4 shows. Costs without retrofit escalate over time (red). A retrofit to Building Regs or a medium retrofit prevents this escalation. Deep retrofits are easily the most cost-effective over the life of this building though these timescales are still a fair bit longer than the typical homeowner is interested in. Many home owners think more in terms of 15 - 30 years – the term of their mortgage – so is it realistic to have 30 year figures? This is where incremental retrofit comes in, an approach brought out in great detail by the Passive House Institute. They also provide the tools to plan it and packaged with PHPP version 9.6a. A homeowner can have a whole retrofit plan developed for their house, which splits the conversion to Enerphit into 3-5 stages. Within their 15 years of interest they could do the first one or two stages, whatever is economic for them, and leave the rest to future owners. After the process is complete the house can receive certification as a conventional retrofit would. The future for retrofit is therefore very promising and this is being helped by REALcosting which gives people confidence to make informed decisions.

For more information on this article please contact: tim@aecb.net

Help Desk

You can't stay warm if your boots are leaking

When a thermal block is used below DPC level, particular care is needed to ensure regs compliance, argues architect and DIT lecturer Simon McGuinness.

I was asked to comment on a photograph sent in by a reader. The building site is, I am told, located in Dublin and the development is new housing. The photograph shows cavity blockwork sitting on a solid block rising wall sitting on a strip foundation. A single course of insulating concrete block has been provided to the inner leaf at what appears to be between the DPC level and the top of the rising wall.

The provision of an insulating concrete block at this point in the construction is intended to address the issue of thermal bridging. By introducing a less conductive block course, the heat loss downwards through the inner leaf and the rising wall can be reduced to such an extent that the minimum temperature factor of 0.75 can be achieved at the skirting board. Linear thermal bridge modelling of the junction will prove whether the temperature factor can be achieved.

A wall U-value of 0.19 W/m^{2}K or better is usually required in Ireland to meet building regulations for new housing (a whole house heat loss calculation is performed using the Dwelling Energy Assessment Process (DEAP) to establish elemental compliance). Using such a cavity wall construction, a rigid PIR insulation board with a water shedding outer facing is typical, fitted tightly to the inner leaf of the cavity wall leaving a residual still air cavity of 20mm or less. A separate insulated drylining board is sometimes added to the inside face of the inner block leaf to improve the U-value.

The Irish government has produced an extensive series of Acceptable Construction Details (ACDs) which cover much of the general detailing required for housing. The particular ACD appropriate for this junction is ACD 1.02b. However, there are a couple of departures from the ACD involved in the photograph, which may prove problematic. The ACD assumes all the insulation will be provided within the cavity, so some of the comments below regarding surface temperature may not apply if additional internal insulation ends up being provided.

Firstly, the ACD presumes a free draining cavity forming a capillary break below the cavity insulation board. Whilst not explicitly referred to in the annotation as a requirement, this is clearly shown in the drawing. This capillary break is not present in the photograph.

The ACD requirement is that the insulation extends 225mm down the outer face of the insulating block below internal floor level. In this case, the cavity insulation will have to start

right at the base of the cavity. The base of the cavity is also horizontal, meaning that water that descends on the inner face of the outer leaf will collect on this ledge. Thus the insulation will be sitting in water. Some types of insulation board are not suitable for seasonal immersion in water. Other types may have facings which are sufficiently water resistant to form an active capillary at the back of the insulation board which, if sitting in water, may even be sufficient to allow water to bypass the DPC on the inner leaf.

Secondly, there is no evidence of a DPC to prevent the insulating concrete block course from absorbing moisture being transported upwards from the ground through the rising wall. Insulating blocks are porous and, when wet, their insulating potential is impaired. A good insulating block will have a certified thermal conductivity of around 0.20W/mK but, when saturated, that can increase to 0.34W/mK, making it much more conductive of heat (less of an insulator). This saturated thermal conductivity figure was measured in a recent test of their own products carried out by one thermal block manufacturer.

Achieving compliance with the surface temperature factor of 0.75 is sometimes difficult in cavity block construction and insulating blocks are often required. A thermal model that achieves the surface temperature using a block with a conductivity of 0.20W/mK could fail to achieve that requirement if the thermal conductivity of the block were to increase to 0.25W/mK, or to 0.34 W/mK.

In those circumstances, the intent of the ACD, to eliminate the cold bridge and thereby achieve the surface temperature factor, would be lost.

The ACD requires that the insulating block must have a thermal conductivity of no more that 0.20 W/mK and be suitable for use below the DPC. The wording could be mistaken to mean that it is structurally suitable to accept the loading required or robust enough to prevent damage from frost heave, and/or resistant to the chemicals found in ground water. In fact, it needs to be suitable for all three and, in addition, must continue to maintain this minimum thermal performance.

Protecting blockwork from rising ground moisture would normally be achieved by providing a DPC between the insulating block course and any damp structures below the DPC, like soil, oversite concrete or rising walls. Alternatively, the blocks can be individually coated with a waterproof tanking solution. It is not sufficient to coat the outside faces as the mortar joints will provide a ready path for moisture to enter the block.

Specifiers must ensure that if a 0.20W/mK block is required to meet a surface temperature factor, it must achieve this conductivity under site conditions and in perpetuity. Its performance cannot be allowed to drop below this level where compliance is critical.

It doesn't really matter if any drop in thermal performance is caused by substitution with a lower-performing block, by ground water absorption, or a combination of both, the bottom line is that if it does, the building no longer complies. Any occurrence of mould on the inner surface of the wall under those circumstances could be attributable to negligence on the part of the designer or the installer.

Want to ask Simon a question? Email ***helpdesk@passivehouseplus.ie***

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